Case Mountain Giant Sequoia Grove Complex

Inventory and Analysis

USDI-Bureau of Land Management
Bakersfield, CA Field Office

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Executive Summary

A comprehensive, integrated resource inventory focused on live and dead vegetation was completed for the Case Mountain giant sequoia grove complex in the fall of 2001. This was a cooperative project between the Bakersfield BLM Field Office and Sequoia National Forest, with BLM providing funding to Sequoia NF for the inventory fieldwork. This project used the standard Forest Service inventory process, slightly customized, where each of the six grove units was sampled for live trees, dead trees, understory vegetation, down logs and surface fuels.

This inventory was done to measure, document and describe existing structural conditions in each of the six giant sequoia grove units on Case Mountain. The following report presents findings of existing grove structural conditions, comparison to desired grove structure as described in the recent study by Piirto and Rogers, and offers appropriate recommendations for grove structural restoration.

While field investigations found all grove units to be in relatively good health, some elements of grove structure were found to be in need of restoration. The most serious concern is the lower slope dense chaparral and deerbrush fuel problems on slopes just below the groves. These live fuels, especially when in dense, continuous stands, can burn very hot and fast during extreme weather conditions. These fuels could allow wildfire to burn into the groves at such high intensity that groves could sustain serious loss, even worse than in the 1987 Case Fire.

The need for thinning dense patches of small trees and removal of ladder fuels is evident to some extent in all grove units. Restoration opportunities are discussed for each grove unit in the following sections.

This report and several other recent studies on Case Mountain have recognized the need for a comprehensive, interdisciplinary management plan for the unique resources on Case Mountain. The BLM has a good opportunity, now that a significant amount of information has been collected, to use local expert resource personnel possibly through the existing Giant Sequoia Cooperative, to involve the interested public in drafting a plan that will outline a management strategy aimed at sustaining the giant sequoia groves on Case Mountain for generations to come.

Maps, graphs, photo galleries, inventory summary reports, original plot data and BLM giant sequoia census data are in the Appendix.

Case Mountain Giant Sequoia Grove Complex Inventory and Analysis

USDI Bureau of Land Management
Bakersfield Field Office

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Introduction

A comprehensive, integrated resource inventory was completed for the Case Mountain giant sequoia grove complex during the fall of 2001. The inventory process described in, "Forest Inventory and Analysis User's Guide" (FIA), USDA–Forest Service, Pacific Southwest Region, 1999, was used as the basis for inventory design and field data collection standards. The inventory design was slightly modified for use in giant sequoia groves, mainly to accommodate very large tree sizes and high stand densities associated with the groves. These design modifications are described in, "Integrated Resource Inventory Design for Giant Sequoia Groves on the Sequoia National Forest", May 1998 by Lewis Jump and Jack Levitan. This inventory was designed to result in data statistically reliable with a 20 percent error term based on square feet of basal area stand density per acre. This inventory sampled live trees, dead trees, understory vegetation, down logs and surface fuels.

This report will begin with general information, followed by sections describing vegetative and fuels attributes of each grove unit. The report will end with conclusions and a summary. Maps, graphs, photo galleries, FIA summary reports and original plot data for each grove unit are located in the Appendix.

Purpose and Design

This inventory is designed to measure and document existing conditions of live and dead vegetation found in each grove unit. Data gained from this project will offer land managers comprehensive information about grove structure, snags, understory vegetation, down logs and surface fuels.

The inventory was designed using permanently located plots which are intended to be re-measured every 10 years. Each grove unit is sampled using a uniform grid pattern specific to each unit. Plot centers were located using latitude and longitude coordinates generated from Arc/Info GIS software, based on the designed grid spacing. Each plot center is located using a steel rebar stake and aluminum tag designating the plot number. Each tree measured has an aluminum tag nailed to the tree at 4.5 feet above the ground facing plot center and scribed with the tree number, corresponding to tree numbers recorded on the tree plot data forms. Each plot center also has an actual field recorded Global Positioning System (GPS) latitude and longitude coordinate assigned.

Establishment of Continuous Forest Inventory (CFI) plots are referenced in the report, "Ecosystem Management Plan for the Case Mountain Giant Sequoia Ecosystem", June 1, 2000, by the Terra

Protection Consulting Agency, Natural Resources Dept., Cal Poly State University, as an objective for the Ecosystem Plan. While this inventory design varies slightly from the design described in the Terra report, a more comprehensive set of data was obtained using the U. S. Forest Service FIA protocol.

Data was collected by grove unit so that each unit can be compared to the others to gain a perspective on existing conditions in each grove and on priorities for possible restoration needs, such as fuel reduction, thinning and individual species regeneration. This inventory is not intended to describe individual stands of trees within grove units for project level analysis. Project level design will require field data collection from individual stands within grove units and site-specific analysis of that data.

The "Comparison of Existing to Desired" sections of this report will offer land managers information on excesses and shortages of trees by species and size class, fuel loading conditions, and a discussion of grove restoration opportunities based on findings about desired giant sequoia grove conditions in the recent publication, "An Ecological Foundation for Management of National Forest Giant Sequoia Ecosystems", by Piirto and Rogers, USDA Forest Service, Pacific Southwest Region, August 1999.

BLM is nearly finished with conducting a giant sequoia tree census in all grove units, including the private land owned my Mr. Cairns. All larger giant sequoia trees are tagged with a tree number, measured for diameter and described by a number of other attributes. Data tables for this tree census are in the Appendix.

Location

Case Mountain is located 6 miles east of the town of Three Rivers, CA, near Sequoia National Park (see location map in the Appendix). Elevations range between 2,500 and 6,818 feet. Giant sequoia groves are located mostly on north aspects between 5,000 and 6,500 feet. Giant sequoia groves on Case Mountain occupy 224 acres on BLM land with the balance of 220 acres on private land. Two roads provide access to the groves: Salt Creek Road (BLM maintained) and Oak Grove Road (privately maintained). Vehicle access is currently restricted to BLM personnel and local private landowners. The general public may access the groves by foot, equestrian and mountain bicycle travel only.

History

The Case Mountain giant sequoia grove complex has had a history of fire, logging and livestock use which have shaped current conditions. Large wildfires have burned over much of Case Mountain and the grove complex. The largest fires in recent history occurred in 1928 and 1987. The 1987 Case Fire burned 4,360 acres and created large, completely burned areas in some of the groves. The more intensely burned areas, located on private lands, from the 1987 Case Fire were planted with giant sequoia seedlings grown from seed obtained from Mountain Home State Demonstration Forest, located about 25 miles southeast of Case Mountain. A recent study, "Case Mountain Fuels Inventory: A Preliminary Survey", 2000, by Moody, Gross and Haynes, Natural Resources Management Dept., Cal Poly State University, examines fire and fuels elements of the Case Mountain giant sequoia ecosystem at length.

Much of the Case Mountain forested areas, including the grove complex, was logged in the 1940's and 1950's, removing at least 40 million board feet of timber. Evidence of this logging still remains, mostly in the form of giant sequoia stumps and cull logs, which are highly resistant to decay. A more recent timber harvest was completed in 1981, in conjunction with a land exchange between a private landowner

and the BLM. This harvest removed about 3 million board feet of mixed conifer timber in several grove units.

Livestock grazing has been fairly intensive, compacting soil in wet areas in and near seeps and springs associated with the groves. Understory vegetation (hardwoods, shrubs and grasses) have been utilized as forage. Livestock grazing is scheduled to be eliminated in 2003.

Results

Each grove unit had a set of permanently located plots installed on a fixed grid pattern. Data from these plots was processed using the U. S. Forest Service FIA software program, which produces detailed reports with data expanded to a per-acre basis. Plot data are described in the following sections, one section for each one of the six grove units.

Recommended Management Variability (RMV) is an expression of desired ecological conditions described in the Piirto and Rogers report. RMV is a range of forest conditions that are believed to allow sustained function and balance of natural processes (fire, hydrology, nutrient cycling, tree growth, plant succession, etc.) that will maintain a healthy and vigorous forest ecosystem. At the end of each section of this report, existing conditions are compared to desired conditions in based on findings in the 1999 study by Piirto and Rogers. Opportunities for grove protection and ecological restoration based on these comparisons will be described for each grove unit.

Grove restoration practices can involve prescribed burning, thinning to remove excess trees of various sizes, site preparation for regeneration, tree planting and mechanical fuel treatments. Data collection and prescription development for grove restoration practices are complex processes and should only be undertaken by a qualified professional forester/silviculturist experienced with giant sequoia grove management. Fuels and other natural resource specialists should be closely involved in grove restoration project planning to ensure objectives for hydrology, soils, wildlife, archaeology, and other resource values are not compromised and apparent conflicts are mitigated.

Nutmeg Grove Unit

This grove unit is the largest in area size at 130.5 acres consisting of giant sequoia and a mixed conifer-black oak forest component . It is located on the northeast side of Case Mountain entirely within a sub-watershed ranging from 5100 and 5800 feet elevation. There are large flowing springs in this grove unit which eventually drain into the East Fork of the Kaweah River. A portion of this grove was acquired by the BLM in 1979 through the same land exchange which involved the Case Unit. The seller retained the rights to harvest 3 million board feet of timber in combination with concurrent logging in the Case Grove Unit.

Sequoia Resource:
There are **33** inventoried giant sequoias that range in size from 3 to 15 feet in diameter (dbh). Four of the 33 trees are located on private property owned by Dave Cairns. In addition, there are an estimated 25 giant sequoias located on a 40 acre privately owned parcel (Hammer) that range from 3 to 12 feet in diameter. There are 2 sequoias located on a 80 acre privately owned parcel (Gavel). Both trees are estimated to be 3 to 4 feet in diameter. There is an estimated total of **62** giant sequoias, sizes ranging from 3 to 15 feet in diameter, in the Nutmeg Grove Unit. There are **187** giant sequoias, sizes ranging from 4.5 to 35.9 inches in diameter, found on BLM lands. The Bureau has a Cooperative Agreement with land-owner David Cairns to conduct studies and inventories on all his private lands since he is interested in best management practices for giant sequoias. Mr. Cairn's private lands encompass approximately one half of the sequoia bearing lands (222 acres), on Case Mountain. Sequoia inventories have not yet been conducted as of 10/01 on Mr. Cairns property in this unit. It is estimated that there are **800** sequoias in the 4.5 to 35.9 inch diameter dbh size on his property. The Bureau does not yet have any cooperative agreements to conduct any inventories on the Hammer and Gavel properties. It is estimated that there are **200** and **25** sequoias growing on the Hammer and Gavel properties, respectively, which range from 4.5 to 35.9 inches in diameter. There are approximately **1200** estimated total sequoias which range from 4.5 to 35.9 inches in diameter in the Nutmeg Grove Unit for all lands. There are approximately **2000** hand-counted, mostly 1987 fire-regenerated sequoias, on the BLM portions of the grove unit. It is estimated that there are even more such regenerated sequoia trees found on the private lands.

Fire History:
The 4360 acre Case Fire of August-September 1987 began as a lightning strike in the Nutmeg Grove Unit. Only portions of the grove unit were burned by a low intensity ground fire. Approximately 50 percent of the grove was affected by this fire. Prior to the 1987 fire, the entire grove unit burned in 1928. Most of the larger sequoias have a fire history as evidenced by large basal fire scars. Smaller sized sequoias often have basal fire scars from the 1987 fire. Prescribed burning is planned for this grove unit within the next 2 to 3 years as of 10/01.

Logging History:
This grove unit was logged during the late 1940's-1950's when it was completely under private ownership and by owners who were not the current landowners. Mixed conifers and large giant sequoias were cut. Approximately 65 large giant sequoia stumps were found and locations documented by Global Positioning System (GPS) latitude and longitude coordinates. One stump measured 54.9 feet in circumference. It appears that this could have been the largest tree at the time on Case Mountain. Approximately 85 percent of the total number of sequoias in the unit were generated by surface-disturbing activities created by logging during the 1940's-50's period. Also a small crop of sequoias can be found in places of disturbance caused by the 1981 logging, which not only included the BLM acquired lands but also the private lands before Dave Cairns became the current landowner. It is estimated that 4 percent of the total number of 4 to 12 inch diameter sequoias are a result caused by regeneration after the 1981 logging. It appears that there were no sequoias logged in this unit during 1981-82. Mixed conifers can still be found in abundance throughout the grove unit. Black oak trees are generally found in the more open areas.

Regeneration:
Scattered giant sequoia nurseries are occasionally found on the BLM portion of the unit. Slightly greater amounts of sequoia reproduction are found on the private lands due to more coverage by the 1987 fire. A few trees are topping the 20 foot tall level. Most are in intense competition with other trees due to close spacing and too much shading. White fir, incense cedar, sugar pine and ponderosa pine saplings can be found abundantly in the grove. There are also some young fire-regenerated California nutmeg saplings found in shaded areas.

Reforestation:
There have been no known planting efforts to restock fire losses within the boundaries of the grove unit. Planted ponderosa pines can be found near the southwest grove boundary. These pines appear to be healthy and somewhat close together. Uphill to the southwest of the unit near the upper northeast side of Case Mountain is a small giant sequoia plantation at the 6450 foot elevation level. This plantation is located on private lands owned by David Cairns and was planted in 1988 one year after the fire. The trees are stock originating from Mountain Home State Demonstration Forest (Mountain Home Grove). There are about 100 trees which are quite robust in appearance at this time.

Inventory Data

The following tables describe current conditions in terms of sampled live and dead vegetation measured on the inventory plots. FIA summary reports for all 14 plots measured in this grove unit and corresponding graphs can be found in the Appendix.

Table 1. **SPECIES COMPOSITION** (percent of total)

SPECIES	*BASAL AREA/AC.*	*TREES/AC.*
Giant sequoia	22	6
Ponderosa pine	12	6
Sugar pine	5	6
White fir	31	20
Incense-cedar	30	62

Table 2. **GROVE DENSITY and TREE STOCKING by DIAMETER CLASS** (conifers)

DIAMETER CLASS *(INCHES DBH)*	*BASAL AREA PER ACRE* *(SQ. FT.)*	*TREES PER ACRE*
1 - 4	10.4	250
5 - 10	40.7	130
11 - 14	21.5	23
15 - 20	55.6	35
21 - 28	27.4	8
29 - 38	17.1	3
39 +	18.6	1
TOTAL	**191.3**	**450**

Table 3. **SEEDLINGS per ACRE**

SPECIES	*NUMBER*
Incense-cedar	574
White fir	290
Ponderosa pine	36
Black oak	36
TOTAL	**936**

Table 4. **ANNUAL GROWTH** *(conifers 11.0 dbh and larger)*

Basal Area per Acre growth = 4.44 sq. ft.
Cubic ft. per Acre growth = 89.1

Table 5. **VEGETATION COVER**

VEGETATION CLASS	*% CANOPY COVER**	*AVG. HEIGHT (FT.)*
Conifers	79	53.6
Hardwoods	21	62.9
Shrubs	16	8.9
Forbs	<1	1.0
Grasses	<1	<1.0
TOTAL	**116**	

* *More than 100% canopy cover indicates overlapping layers*

Table 6. **UNDERSTORY VEGETATION**

SPECIES	*% COVER*	*AVG. HEIGHT (FT.)*
Deerbrush	11.9	10.5
Hazelnut	1.6	7.8
Gooseberry	0.7	1.6
Snowberry	0.4	1.0
Whiteleaf manzanita	0.4	1.4
Wild rose	0.4	1.0
Currant	0.4	3.0
Bush chinquapin	0.4	7.0
Blue elderberry	0.1	5.0
TOTAL	**16.3**	

Table 7. **SNAGS per ACRE by CROWN POSITION**

GROUP	*DOMINANT*	*CODOM.*	*INTERMED.*	*SUPPRESSED*	*TOTAL*
Conifers	1.4	3.7	1.4	0	**6.5**
Hardwoods	0.9	0.9	0.3	0	**2.1**
TOTAL	**2.3**	**4.6**	**1.7**	**0**	**8.6**

Table 8. **DOWN LOGS per ACRE by DIAMETER CLASS**

DIA. CLASS (IN.)	*# LOGS*	*TONS/AC.*	*CU. FT./AC.*
10 – 15.9	21	2.58	254.5
16 – 23.9	9	2.75	296.3
24 +	8	12.63	1,451.0
TOTAL	**38**	**17.96**	**2,001.8**

Table 9. **SURFACE FUELS**

DIA. CLASS (IN.)	*WEIGHT (TONS/AC.)*
Duff *	10.34
0 – 1.0	2.72
1.1 – 3.0	3.54
3.1 – 9.0	4.47
9.1 – 20.0	5.24
20.1 +	12.72
TOTAL	**39.03**

* *Duff is calculated at 9.4 tons/ac. per inch of duff depth; from Haase 1996 study of fuel weights in giant sequoia groves.*

The following tables compare key elements of current grove structure to desired structure as described by Piirto and Rogers.

Table 10. **COMPARISON of CURRENT to DESIRED GROVE STRUCTURE**

SPECIES	*CURRENT*	*DESIRED*
Giant sequoia	6% of trees, 22% of BA/ac.	10% of trees, 65% of BA/ac.
Mixed conifer	94% of trees, 78% of BA/ac.	90% of trees, 35% of BA/ac.
White fir	30% of BA/ac.	15% of BA/ac.

Table 11. **COMPARISON of CURRENT to DESIRED SURFACE FUELS** (tons per acre)

FUEL SIZE CLASS (IN.)	*CURRENT*	*DESIRED*
Duff	10.34	5 - 15
0 - 1	2.72	1 - 2
1 - 3	3.54	1 - 3
3 - 9	4.47	1 - 3
> 9	17.96	10 - 20
TOTAL	**39.03**	**18 - 43**

Discussion

Species composition (reference Table 10.) Although the Nutmeg grove unit has a good representation of giant sequoia trees as documented by the BLM tree census, this inventory indicates that giant sequoia represents only 6 percent of all trees, just a little more than half RMV; and 22 percent of basal area per acre, one-third of RMV. This demonstrates a relative surplus of other conifers, especially white fir and incense-cedar, typical of most groves where wildfire has been largely suppressed during the past several decades. This inventory did not find any significant numbers of fire-regenerated giant sequoias from the 1987 burn. White fir is currently double the RMV of 15 percent of average basal area per acre.

Obvious surplus trees exist in the 5-10 and 15-20 inch dbh classes, mostly white fir and incense-cedar. Considering that the grove averages 191 square feet of basal area per acre with an average conifer crown cover of 79 percent, some stands are overstocked with white fir and incense-cedar. Other diameter classes are reasonably well balanced.

Regeneration of shade intolerant species (pines, black oak and giant sequoia) is poor, also indicating the need for canopy gap creation to allow sunlight to reach the forest floor which will help promote germination and growth of these species.

Surface fuels (reference Table 11.) Surface fuels are remarkably close to RMV in all classes, probably a result of the 1987 Case Fire. The 0-9 inch classes, however, are slightly above RMV indicating a need for a prescribed burn. The RMV fire return interval is 5-20 years, so timing of a light to moderate prescribed burn within the next few years would be consistent with the RMV recommendation. The 9-inch and larger fuel size class is nearing the RMV upper limit. These larger sized fuels could also be reduced to the mid-range RMV by a prescribed burn.

Summary and Conclusions

Overall, the Nutmeg grove unit is healthy and not in need of major restoration, considering the recommended ranges of key grove structure elements. However, there are obvious indications of shortages of ponderosa pine, sugar pine, black oak and giant sequoia seedlings and an overstocked condition of white fir and incense-cedar, especially in the 5-10 and 15-20 inch dbh classes. Overstocked conditions also exist in scattered patches of sapling and pole-sized trees which need thinning to restore reasonable growth rates and vigor.

If left untreated, overstocked conditions in this grove will contribute to increasing risk of loss to sustained crown fire, should fire enter the Nutmeg unit under extreme conditions as it did in 1987. Overstocked stands also cause trees to stress during the summer months, creating favorable conditions for loss to bark beetles and other destructive insects. Spread of forest tree pathogens such as dwarf mistletoes and root rot can also accelerate in overstocked stands.

Opportunities to balance grove structure exist by using combinations of prescribed burning and tree thinning practices. Generally, mechanical treatments should precede prescribed burning so that fuels can be treated to control flame length during burning, minimizing unwanted loss of trees. Smaller white fir and incense-cedar could be thinned where occurring in dense patches, or growing under the crowns of larger trees. Larger white fir and incense-cedar could be removed where they are contributing as ladder fuels next to larger trees, especially giant sequoia.

Canopy gaps (1/2 to 2 acres) could be created in appropriate locations to encourage ponderosa pine, sugar pine and giant sequoia regeneration. These gaps do not need to be clearcuts, but canopy cover should be reduced to 20 to 40 percent to allow sunlight to reach the forest floor. These gaps should be located adjacent to pine and giant sequoia seed-bearing trees where possible. Site preparation will need to be done in these gaps to expose at least 50 percent mineral soil. This can be done with a combination of mechanical and burning methods. These gaps could be planted with pine and sequoia seedlings to assure regeneration and good early growth.

There are significant areas of deerbrush in this grove which could be a fire hazard in extreme burning conditions. Areas of dense deerbrush could be reduced in conjunction with other restoration activities.

The Nutmeg grove unit could probably be treated in a single entry to return all key structural elements to recommended ranges, allowing natural fire to return to the grove without high risk of catastrophic loss. If left untreated for another 10 to 20 years, two or more entries may be needed to achieve the recommended grove structure.

Case Grove Unit

This grove unit is second largest in area size at 126.7 acres consisting of giant sequoia and a mixed conifer-black oak forest component. It is located on the northwest side of Case Mountain entirely within the confines of a sub-watershed ranging between 5400 and 6400 feet elevation. There are large flowing springs in this grove which eventually flow into Salt Creek. Of interest is that this entire grove unit was acquired in 1979 by the BLM through a land exchange. The seller retained the rights to harvest 3 million board feet of timber for this grove unit, and portions of the Nutmeg grove unit. Timber harvest was completed in both grove units during 1981.

Sequoia Resource:
There are **101** giant sequoias that range in size from 3 to 16 feet in diameter, **1096** sequoias that range in size from 4.5 to 35.9 inches in diameter and approximately **6000** hand-counted mostly 12 to14 year-old fire-regenerated sequoia trees. The largest standing sequoia on Case Mountain measures just over 50 feet in circumference and resides in this grove unit. All trees are located on BLM lands.

Fire History:
Portions of this grove were burned by the Case Fire of 1987. Approximately 60 percent of the grove area was burned by a generally low intensity ground fire in 1987. The entire grove unit was burned in 1928. Most of the larger trees have a fire history as evidenced by large basal fire scars. Many young sequoias also have fire scars resulting from the 1987 fire. There is evidence that some young sequoias with 1987 fire scars have been toppling due to ongoing basal rot in the fire scars. Prescribed burning of this grove unit is planned for the future.

Logging History:
This grove unit was logged during the late 1940's to the mid 1950's for mixed conifer. Only 6 giant sequoias ranging in size from 8 to 12 feet in diameter were cut during this period. Logging of mixed conifers again occurred during 1981 per acquisition agreement. Approximately 90 percent of the sequoias 4.5 to 35.9 inches in diameter are generated from 1940-1950's surface disturbance caused by various logging activities. Possibly 3 percent of the young sequoias (4.5 to 12 inches in diameter) were generated by the later 1981 logging activity. Mixed conifers can be found abundantly in the grove area. Black oak trees are generally found in the more open areas.

Regeneration:
Scattered giant sequoia nurseries are found in this grove unit, more so than the other six grove units. Some of the most vigorous trees are 20 feet tall as of 2000. Many are stunted due to competition and excessive shade. White fir, incense cedar, sugar pine and ponderosa pine saplings can be found within the grove area.

Reforestation:
There are no known plantings of any tree species in this grove unit.

Inventory Data

The following tables describe current conditions in terms of sampled live and dead vegetation measured on the inventory plots. FIA summary reports for all 17 plots measured in this grove unit and corresponding graphs can be found in the Appendix.

Table 1. **SPECIES COMPOSITION** (percent of total)

SPECIES	*BASAL AREA/AC.*	*TREES/AC.*
Giant sequoia	24	25
Sugar pine	14	9
White fir	52	41
Incense-cedar	10	25

Table 2. **GROVE DENSITY and TREE STOCKING by DIAMETER CLASS** (conifers)

DIAMETER CLASS *(INCHES DBH)*	*BASAL AREA PER ACRE* *(SQ. FT.)*	*TREES PER ACRE*
1 - 4	4.7	141
5 - 10	14.9	43
11 - 14	19.9	23
15 - 20	45.9	27
21 - 28	34.6	11
29 - 38	18.8	3
39 +	39.4	1
TOTAL	**178.2**	**249**

Table 3. **SEEDLINGS per ACRE**

SPECIES	*NUMBER*
White fir	418
Incense-cedar	229
Black oak	71
Giant sequoia	23
Sugar pine	18
CA nutmeg	6
TOTAL	**765**

Table 4. **ANNUAL GROWTH** *(conifers 11.0 dbh and larger)*

Basal Area per Acre growth = 2.95 sq. ft.
Cubic ft. per Acre growth = 76.2

Table 5. **VEGETATION COVER**

VEGETATION CLASS	*% CANOPY COVER*	*AVG. HEIGHT (FT.)*
Conifers	51	78
Hardwoods	8	56
Shrubs	14	6
Forbs	<1	1
Grasses	<1	<1
TOTAL	**73**	

Table 6. **UNDERSTORY VEGETATION**

SPECIES	*% COVER*	*AVG. HEIGHT (FT.)*
Deerbrush	9.5	8.1
Gooseberry	2.7	1.3
Hazelnut	0.7	4.9
Snowberry	0.3	1.0
Wild rose	0.3	1.0
Currant	0.2	2.7
Willow	0.1	7.0
TOTAL	**13.8**	

Table 7. **SNAGS per ACRE by CROWN POSITION**

GROUP	*DOMINANT*	*CODOM.*	*INTERMED.*	*SUPPRESSED*	*TOTAL*
Conifers	0.24	1.65	4.47	0	**6.35**
Hardwoods	0	0.24	0.71	0	**0.94**
TOTAL	**0.24**	**1.89**	**5.18**	**0**	**7.29**

Table 8. **DOWN LOGS per ACRE by DIAMETER CLASS**

DIA. CLASS (IN.)	*# LOGS*	*TONS/AC.*	*CU. FT./AC.*
10 – 15.9	18	2.75	230.29
16 – 23.9	8	2.55	300.31
24 +	5	24.39	2,267.93
TOTAL	**31**	**29.69**	**2,798.53**

Table 9. **SURFACE FUELS**

DIA. CLASS (IN.)	*WEIGHT (TONS/AC.)*
Duff *	7.52
0 – 1.0	2.32
1.1 – 3.0	2.85
3.1 – 9.0	2.89
9.1 – 20.0	4.94
20.1 +	24.75
TOTAL	**45.26**

* *Duff is calculated at 9.4 tons/ac. per inch of duff depth; from Haase 1996 study of fuel weights in giant sequoia groves.*

The following tables compare key elements of current grove structure to desired structure as described by Piirto and Rogers.

Table 10. **COMPARISON of CURRENT to DESIRED GROVE STRUCTURE**

SPECIES	*CURRENT*	*DESIRED*
Giant sequoia	25% of trees, 24% of BA/ac.	10% of trees, 65% of BA/ac.
Mixed conifer	75% of trees, 76% of BA/ac.	90% of trees, 35% of BA/ac.
White fir	52% of BA/ac.	15% of BA/ac.

Table 11. **COMPARISON of CURRENT to DESIRED SURFACE FUELS** (tons per acre)

FUEL SIZE CLASS (IN.)	*CURRENT*	*DESIRED*
Duff	7.5	5 - 15
0 - 1	2.3	1 - 2
1 - 3	2.8	1 - 3
3 - 9	2.9	1 - 3
> 9	29.7	10 - 20
TOTAL	**45.2**	**18 - 43**

Discussion

Species composition (reference Table 10.) There is actually a surplus of giant sequoia trees in this grove, slightly more than double the RMV of 10 percent of all trees. Basal area of giant sequoia trees, however, is only about one-third of the 65 percent RMV. This simply indicates that the giant sequoia tree population is of relatively small size compared to what would be considered in a mature grove. There are situations where giant sequoia trees are competing with each other, notably in the 15 – 20 inch diameter class. Removal of some of these by "thinning from below" would be warranted to restore good growth rates and vigor on the remaining trees. Candidate future "specimen trees" could be released, in this case, of competing trees so they might reach large size and old-growth character at a faster rate.

Mixed conifer species represent 75 percent of all trees, somewhat under the RMV of 90 percent. Mixed conifer represents 76 percent of basal area per acre (more than double RMV), indicating the relatively small number of large giant sequoia trees. Larger mixed conifer trees are, in some cases, competing with

neighboring giant sequoias and are also in ladder fuel positions. Appropriate removal of these trees seems warranted as a grove restoration measure. The species of choice for consideration of removal would be white fir, as indicated in Table 10 (52 percent of basal area per acre). A small surplus of trees exists in the 1-10 inch diameter classes, representing patches of young trees that need thinning. Other diameter classes seem reasonably well balanced.

The Case grove unit is becoming too dense for favorable regeneration of shade intolerant species such as pines and giant sequoia. It is notable that virtually no ponderosa pine seedlings were counted in this grove, indicating a need for creating canopy gaps to allow sunlight to reach the forest floor to promote germination and growth of pines and giant sequoia.

Surface fuels (reference Table 11.) Surface fuels in the Case grove unit are remarkably close to RMV in all size classes except the greater than 9 inch class, probably a result of the 1987 Case Fire. The 9 inch and larger fuel class is double that of mid-range RMV. Most of this excess fuel loading is in the 24 inch and larger down logs (Table 8). The 0-9 inch fuels are near or slightly above RMV limits, indicating the need for a light to moderate prescribed burn within the next few years.

Summary and Conclusions

Overall, the Case grove unit is healthy and not in need of major restoration, considering the recommended ranges of key grove structure elements. However, there are indications that conditions are no longer favorable for intolerant species regeneration. White fir, in particular, is overstocked in this grove, mostly in the 1 - 10 inch diameter classes. According to RMV, about 37 percent of white fir basal area per acre should be removed in the overstocked diameter classes.

Opportunities for returning this grove to RMV are similar to those described previously for the Nutmeg grove unit. Patches of heavily stocked smaller trees are in need of thinning as tree growth is becoming stagnated. A spacing of 16 to 24 feet between leave trees is usually recommended in these sapling to pole-sized patches.

Deerbrush is the most common woody shrub in this grove. Dense patches could be reduced in size and continuity in conjunction with other restoration measures to lower the wildfire-carrying potential of this species during extreme burning conditions.

The Case grove unit could probably be treated in a single entry to return all key structural elements to recommended ranges, allowing natural fire to return to the grove without high risk of catastrophic loss. If left untreated for another 10 to 20 years, two or more entries may be needed to achieve the recommended grove structure.

Monache Tubs Grove Unit

This grove unit is 69.5 acres in size. It is located about a mile southeast of Case Mountain off the north side of Salt Creek Ridge and within the confines of a sub-watershed that flows into the East Fork of the Kaweah River. Case Mountain at 6818 feet elevation is basically a high point along Salt Creek Ridge which continues southeastward and upward into Sequoia-Kings Canyon National Park. There are large flowing springs located in this grove. The grove unit ranges from 5500 to 6300 feet in elevation. The south half of the grove is located on BLM lands and retains most of its large sequoias while the private portions have been logged of most of its larger sequoias during the 1940's-50's. One 10-foot diameter sequoia was cut in 1982 by different owners prior to David Cairns's purchase of the private land portions of this grove unit.

Sequoia Resource:
There are **48** giant sequoias that range in size from 3 to 15 feet in diameter, **297** sequoias that range in size from 4.5 to 35.9 inches in diameter and approximately **1500** hand-counted, mostly 1987 fire regenerated sequoia trees, all of which are located on BLM lands. There are **2** large sequoias located on private lands which are 4 and 5 feet in diameter. Sequoias sized from 4.5 to 35.9 inches in diameter have not yet been counted on private lands. It appears that fewer than **50** sequoias will be found in that size class. Most of the larger sequoias were logged fifty years ago. The 1987 fire crowned out across the lower portions of this grove taking out most conifers, including small sequoias, thus resulting in brush growing over slash with occasional living conifers. A few large sequoia stumps can be found under the brush.

Fire History:
In 1987 the 4360 acre Case Fire crowned out to the east of the grove unit on strong east winds created by downdrafting from a nearby thunderstorm. Flames raced westward into the grove. The lower half of the grove consisted of smaller sized mixed conifers and small sequoias which were completely and rapidly destroyed by fire. The lower portion now contains heavy stands of predominantly deer brush, (*Ceanothus integerrimus*) over the area. The BLM portion fared better as the fire was mainly confined to the ground with occasional flare-ups. The entire grove unit was burned. The three other grove units located further east were also affected by the same crown fire event. The previous fire prior to 1987 occurred in 1928. Many of the larger sequoias have basal fire scars as well as many of the smaller sized sequoias. Prescribed burning is slated for 2003.

Logging History:
This grove unit was logged during the late 1940's to the mid-1950's for its mixed conifers and larger giant sequoias mainly on the private land portions. Mixed conifers were harvested on the BLM portions while the sequoia resource remains intact. Logging again occurred during 1982 on the private portions only. Mixed conifers were taken and one 10-foot diameter sequoia was also cut. This harvest was made by previous landowners before sale of property in 1983. Approximately 90 percent of the sequoias on BLM are logging-regenerated trees ranging in size from 4.5 to 35.9 inches in diameter. Few sequoias of this size class survived the 1987 fire across the lower private portion of the grove. A good selection of mixed conifers can still be found in the BLM portion of the grove unit in addition to black oak being found in the more open areas.

Regeneration:
Small but scattered 1987 fire-regenerated giant sequoia nurseries are found mainly on the BLM portions of the grove. Some of these young trees are up to 15 feet tall as of 2001. Many are stunted due to competition and excessive shading. Young white fir, incense cedar, sugar pine and ponderosa pine saplings can be commonly found throughout the grove.

Reforestation:
Giant sequoia seedlings were planted in 1988 soon after the fire was out on the private sections of the grove by landowner Cairns. Approximately 400 robust sequoia saplings ranging to 25 feet in height can be found dotted throughout the brush-covered slopes below Coffeepot Road. Some of these young trees are already bearing cones. The sequoia stock originated from the Mountain Home Grove approximately 25 miles southeast of the Case Mountain area. There is also a small planting of the same sequoia stock located 1/3 mile upslope and west of the grove unit boundary. Approximately 15 healthy trees can be found in this isolated planting. In addition, there are several hundred healthy planted ponderosa pines from 1988 which are located adjacent to the lower west side of the grove unit.

Inventory Data

The following tables describe current conditions in terms of sampled live and dead vegetation measured on the inventory plots. FIA summary reports for all 13 plots measured in this grove unit and corresponding graphs can be found in the Appendix.

Table 1. **SPECIES COMPOSITION** (percent of total)

SPECIES	*BASAL AREA/AC.*	*TREES/AC.*
Giant sequoia	29	54
Ponderosa pine	3	1
Sugar pine	10	3
White fir	47	36
Incense-cedar	11	6

Table 2. **GROVE DENSITY and TREE STOCKING by DIAMETER CLASS** (conifers)

DIAMETER CLASS *(INCHES DBH)*	*BASAL AREA PER ACRE* *(SQ. FT.)*	*TREES PER ACRE*
1 - 4	6.5	105
5 - 10	35.4	107
11 - 14	18.5	21
15 - 20	21.8	12
21 - 28	14.6	4
29 - 38	18.0	3
39 +	9.7	1
TOTAL	**124.5**	**253**

Table 3. **SEEDLINGS per ACRE**

SPECIES	*NUMBER*
White fir	131
Incense-cedar	177
Giant sequoia	77
Sugar pine	30
Ponderosa pine	31
TOTAL	**446**

Table 4. **ANNUAL GROWTH** *(conifers 11.0 dbh and larger)*

Basal Area per Acre growth = 3.68 sq. ft.
Cubic ft. per Acre growth = 41.7

Table 5. **VEGETATION COVER**

VEGETATION CLASS	*% CANOPY COVER*	*AVG. HEIGHT (FT.)*
Conifers	46	50
Hardwoods	3	19
Shrubs	43	8
Forbs	1	1
Grasses	1	<1
TOTAL	**94**	

Table 6. **UNDERSTORY VEGETATION**

SPECIES	*% COVER*	*AVG. HEIGHT (FT.)*
Deerbrush	26.4	10.7
Blueblossom ceanothus	7.1	3.0
Bear clover	1.9	1.0
Hazelnut	1.6	6.4
Whiteleaf manzanita	0.9	5.3
Gooseberry	0.8	1.8
Currant	1.5	5.0
Western azalea	0.8	4.0
Snowberry	0.8	1.0
Wild rose	0.7	1.0
Bush chinquapin	0.3	1.0
TOTAL	**42.9**	

Table 7. **SNAGS per ACRE by CROWN POSITION**

GROUP	*DOMINANT*	*CODOM.*	*INTERMED.*	*SUPPRESSED*	*TOTAL*
Conifers	4.0	8.0	1.8	0.6	**14.4**
Hardwoods	0	3.1	1.2	0.3	**4.6**
TOTAL	**4.0**	**11.1**	**3.0**	**0.9**	**19.0**

Table 8. **DOWN LOGS per ACRE by DIAMETER CLASS**

DIA. CLASS (IN.)	*# LOGS*	*TONS/AC.*	*CU. FT./AC.*
10 – 15.9	19	2.58	261.8
16 – 23.9	11	3.95	439.7
24 +	3	24.92	2,373.2
TOTAL	**33**	**31.45**	**2,001.8**

Table 9. **SURFACE FUELS**

DIA. CLASS (IN.)	*WEIGHT (TONS/AC.)*
Duff *	12.22
0 – 1.0	3.68
1.1 – 3.0	6.49
3.1 – 9.0	6.81
9.1 – 20.0	6.54
20.1 +	24.92
TOTAL	**60.66**

* *Duff is calculated at 9.4 tons/ac. per inch of duff depth; from Haase 1996 study of fuel weights in giant sequoia groves.*

The following tables compare key elements of current grove structure to desired structure as described by Piirto and Rogers.

Table 10. **COMPARISON of CURRENT to DESIRED GROVE STRUCTURE**

SPECIES	*CURRENT*	*DESIRED*
Giant sequoia	54% of trees, 29% of BA/ac.	10% of trees, 65% of BA/ac.
Mixed conifer	46% of trees, 71% of BA/ac.	90% of trees, 35% of BA/ac.
White fir	47% of BA/ac.	15% of BA/ac.

Table 11. **COMPARISON of CURRENT to DESIRED SURFACE FUELS** (tons per acre)

FUEL SIZE CLASS (IN.)	*CURRENT*	*DESIRED*
Duff	12	5 - 15
0 - 1	4	1 - 2
1 - 3	6	1 - 3
3 - 9	7	1 - 3
> 9	31	10 - 20
TOTAL	**60**	**18 - 43**

Discussion

Species composition (reference Table 10.) The inventory projected a notable surplus of giant sequoia trees, about 5 times the RMV of 10 percent of all trees. Much of this apparent surplus is in fire-regenerated sapling to pole-sized trees. The surplus measured by the inventory occurred by the random chance of several plots falling into relatively small patches of very dense giant sequoia regeneration. Giant sequoias account for 29 percent of basal area per acre, less than half RMV, indicating most sequoias are of relatively small size. Patches of dense giant sequoia sapling and pole-sized trees need thinning to restore reasonable growth and vigor.

Mixed conifer represents 46 percent of all trees, only half of RMV. Basal area of mixed conifer accounts for 71 percent, double RMV. Referencing Table 3, it is obvious there are not a lot of large trees in this grove, a result of intense burning in this area during the 1987 Case Fire. The Monache Tubs grove is therefore generally in a regeneration phase (much more so on the lower slopes where dense stands of deerbrush occur). Shrubs account for nearly the same percentage of cover (43), as conifers (46). Distribution of conifers is mainly limited to areas where the Case Fire burned less intensely, on the upper

slopes of the grove. Large stands of shrubs, mostly deerbrush, occur on the severely burned lower slope areas of the grove.

Conifer regeneration is generally good overall, averaging 446 seedlings per acre. Most of these seedlings, however, are white fir and incense-cedar, indicating poor conditions for regeneration of shade intolerant species such as pine, oak and giant sequoia, in the denser conifer stands. Few seedlings and saplings are believed to occur in the dense stands of deerbrush.

Except for a shortage of 1-4 inch diameter trees, diameter classes are reasonably well balanced in the conifer stands. There does appear to be a relative surplus of white fir in the 5-10 inch diameter classes. Tree distribution, however, is far from even, with most of the conifers located in the upper portions of the grove where the Case Fire burned less intensely. White fir accounts for 3 times RMV basal area per acre. Since conifers are concentrated on the upper slopes of this grove, removal of excess white fir, especially in the 5-10 inch diameter classes, deserves consideration.

Shade intolerant species are not regenerating well in the upper portions of the grove, indicating a closing canopy in the larger continuous stands of conifers. No black oak seedlings were counted in this grove.

Surface fuels (reference Table 11). Surface fuels in the Monache Tubs grove are higher than RMV in all size classes, totaling 60 tons per acre which is double the mid-range RMV. Much of this fuel is a direct result of the 1987 Case Fire. The large, continuous, dense stands of deerbrush on the lower slopes and double RMV amounts of all fuel size classes (except duff) places this grove at very high risk of loss to wildfire under extreme burning conditions. This grove should have high priority for fuel treatment.

Summary and Conclusions

As this grove was one of the more intensely burned during the 1987 Case Fire, most key structural elements are at significant departure from RMV. Examination of the upper slopes containing most of the conifer stands would probably find conditions much closer to RMV. Since this inventory sampled entire grove units as single populations, average values for this grove, which has two distinct and extremely different conditions, have limited use for defining specific structural conditions and corresponding opportunities for restoration. Site specific examinations at the stand level will reveal much more accurate existing conditions.

After observing these conditions in the field, however, it is reasonable to assume restoration needs similar to other grove units on Case Mountain exist in the conifer stands on the upper slopes. Some thinning is obviously needed in the 5-10 inch diameter classes and a few canopy gaps need to be created on the upper slopes to promote pine, oak and giant sequoia regeneration. There are a few small patches of fire-regenerated saplings and pole-sized trees that need thinning to restore reasonable growth and vigor.

The primary restoration need for this grove is treatment of the large, dense, continuous stands of deerbrush. The average height of deerbrush is 8 feet, so some mechanical treatment may be needed before burning. Deerbrush stands should be examined for existing conifer seedlings and saplings before treatment to determine if enough trees exist within the stands to warrant protection from treatment activities.

Approximately 400 planted giant sequoias, 15-25 feet in height are growing throughout the lower slopes covered with deerbrush. These trees are well above the deerbrush and appear to be growing vigorously.

These trees will eventually shade out the deerbrush, so releasing these trees from brush competition may not be necessary. Geographically, the most efficient way to treat the deerbrush may be to construct a fire line below the trees across the bottom of the unit, secured on either end by roads. Then the deerbrush may carefully be treated with prescribed fire while protecting the planted trees above the fire line.

Ladybug Grove Unit

This grove unit is 10.6 acres in size and is the smallest of the six units. The forest canopy consists of mixed conifers, giant sequoia and black oak. It is located about 1/3 mile east of the Monache Tubs Grove and is off the northeast side of Salt Creek Ridge and completely within the confines of a small sub-watershed which drains into the East Fork of the Kaweah River. There is a large flowing spring in this unit. Elevations range from 5600 to 6000 feet within the grove. The west half of the grove is located on BLM lands while the east half is located on property owned by Mr. Cairns. There are 3 large sequoias on BLM and 3 on private land. Five large sequoia stumps can be found on the private land. These were cut by different landowners during the 1940's-50's logging period.

Sequoia Resource:
There are a total of **6** giant sequoias (3 are located on BLM) that range in size from 5 to 11 feet in diameter, **176** trees from 4.5 to 35.9 inches in diameter, and approximately **200** hand-counted 1987 Case Fire-regenerated sequoias, all located on BLM lands. It is estimated that there are approximately **100** sequoias ranging in size from 4.5 to 35.9 inches in diameter on the private lands and a similar number of 1987 fire-regenerated sequoias. All of the 4.5 to 35.9 inch diameter trees were generated by the 1940's-50's logging activity where sequoia and mixed conifers were harvested.

Fire History:
Fire burned through the entire grove unit in 1987. The BLM portions of this grove were affected by a ground fire while a few portions of the private side of the grove were affected by a crown fire. Conifers growing in areas below this grove unit were completely destroyed where large brushfields are now found. The fire of 1928 completely burned through this grove. Most of the larger sequoias have basal fire scars as well as many smaller sequoias. Prescribed burning is slated for 2003.

Logging History:
This grove unit was logged during the 1940's -50's for both mixed conifers and sequoias. Both sequoias and mixed conifers were taken from private lands at that time, while only the mixed conifer component was logged on BLM lands. There are 5 large sequoia stumps found from the earlier logging period located on the private land portion of the unit. Approximately 95 percent of the sequoias located in this unit are generated by the early logging activities. It does not appear that any logging occurred in this grove during 1982 by previous landowners. There is a good population of mixed conifers to be found in the unit at this time. Black oak is generally found in the more open areas.

Regeneration:
A few scattered pockets of 1987 Case Fire regenerated sequoias can be found in the grove unit. Some of these young sequoias can be found growing outside what was once the old grove boundary, thus the grove unit has expanded in area since the 1987 fire. A few of these trees are now 18 feet tall. Most are small due to shading and competition. Young mixed conifers are found throughout the grove area.

Reforestation:
There appears to be no replanted trees in this grove unit.

Inventory Data

The following tables describe current conditions in terms of sampled live and dead vegetation measured on the inventory plots. FIA summary reports for all 7 plots measured in this grove unit and corresponding graphs can be found in the Appendix.

Table 1. **SPECIES COMPOSITION** (percent of total)

SPECIES	*BASAL AREA/AC.*	*TREES/AC.*
Giant sequoia	30	20
Sugar pine	5	14
White fir	37	39
Incense-cedar	28	27

Table 2. **GROVE DENSITY and TREE STOCKING by DIAMETER CLASS** (conifers)

DIAMETER CLASS *(INCHES DBH)*	*BASAL AREA PER ACRE* *(SQ. FT.)*	*TREES PER ACRE*
1 - 4	1.4	19
5 - 10	7.9	15
11 - 14	19.8	22
15 - 20	20.5	11
21 - 28	26.4	9
29 - 38	17.1	3
39 +	50.4	2
TOTAL	**143.5**	**81**

Table 3. **SEEDLINGS per ACRE**

SPECIES	*NUMBER*
White fir	343
Incense-cedar	86
Giant sequoia	157
Sugar pine	43
Black oak	43
Ponderosa pine	14
TOTAL	**643**

Table 4. **ANNUAL GROWTH** *(conifers 11.0 dbh and larger)*

Basal Area per Acre growth = 3.47sq. ft.
Cubic ft. per Acre growth = 94.6

Table 5. **VEGETATION COVER**

VEGETATION CLASS	*% CANOPY COVER*	*AVG. HEIGHT (FT.)*
Conifers	27	100
Hardwoods	0	0
Shrubs	41	8
Forbs	5	1
Grasses	0	<1
TOTAL	**73**	

Table 6. **UNDERSTORY VEGETATION**

SPECIES	*% COVER*	*AVG. HEIGHT (FT.)*
Deerbrush	36.4	8.5
Bear clover	0.6	1.0
Hazelnut	1.0	6.6
Gooseberry	0.4	1.7
Currant	1.4	3.0
Snowberry	0.3	1.0
Wild rose	0.9	1.0
TOTAL	**41.0**	

Table 7. **SNAGS per ACRE by CROWN POSITION**

GROUP	*DOMINANT*	*CODOM.*	*INTERMED.*	*SUPPRESSED*	*TOTAL*
Conifers	0.6	6.3	4.6	0	**11.5**
Hardwoods	0.6	0	0	0	**0.6**
TOTAL	**1.2**	**6.3**	**4.6**	**0**	**12.1**

Table 8. **DOWN LOGS per ACRE by DIAMETER CLASS**

DIA. CLASS (IN.)	*# LOGS*	*TONS/AC.*	*CU. FT./AC.*
10 – 15.9	28	4.00	430.8
16 – 23.9	14	4.84	521.8
24 +	5	8.13	935.4
TOTAL	**47**	**16.97**	**1,888.0**

Table 9. **SURFACE FUELS**

DIA. CLASS (IN.)	*WEIGHT (TONS/AC.)*
Duff *	5.64
0 – 1.0	4.00
1.1 – 3.0	6.74
3.1 – 9.0	5.60
9.1 – 20.0	8.86
20.1 +	8.13
TOTAL	**38.97**

* *Duff is calculated at 9.4 tons/ac. per inch of duff depth; from Haase 1996 study of fuel weights in giant sequoia groves.*

The following tables compare key elements of current grove structure to desired structure as described by Piirto and Rogers.

Table 10. **COMPARISON of CURRENT to DESIRED GROVE STRUCTURE**

SPECIES	*CURRENT*	*DESIRED*
Giant sequoia	20% of trees, 30% of BA/ac.	10% of trees, 65% of BA/ac.
Mixed conifer	80% of trees, 70% of BA/ac.	90% of trees, 35% of BA/ac.
White fir	37% of BA/ac.	15% of BA/ac.

Table 11. **COMPARISON of CURRENT to DESIRED SURFACE FUELS** (tons per acre)

FUEL SIZE CLASS (IN.)	*CURRENT*	*DESIRED*
Duff	5.64	5 - 15
0 - 1	4.00	1 - 2
1 - 3	6.74	1 - 3
3 - 9	5.60	1 - 3
> 9	16.99	10 - 20
TOTAL	**38.97**	**18 - 43**

Discussion

Species composition (reference Table 10.) Giant sequoia currently represents 20 percent of all trees, double RMV. Most of this apparent excess is in small patches of pole-sized trees regenerated after the 1987 Case Fire. Basal area per acre of giant sequoia trees is 30 percent, slightly less than half RMV, indicating a relatively small average size compared to what would be found in a mature grove.

Mixed conifer represents 80 percent of trees, close to RMV of 90 percent. Basal area per acre of mixed conifer is 70 percent, twice the RMV of 35 percent. This demonstrates the relative higher number of larger mixed conifer trees to giant sequoia. Since this small grove was completely burned over by the 1928 and 1987 fires, the grove averages only 81 trees per acre (Table 2). Total basal area per acre, however, is 143.5 square feet per acre, so the grove area can be considered adequately stocked.

The Ladybug grove unit averages 643 seedlings per acre (Table 3), 157 of which are giant sequoia. So the grove is recovering nicely from the 1987 Case Fire. Considering the fully stocked seedling population along with all larger trees, species composition of the grove unit and diameter class distribution are adequate and reasonably balanced.

There is a relative surplus of white fir which is currently at 37 percent of basal area per acre, more than double RMV.

Surface fuels (reference Table 11.) Only the 0-9 inch fuel size classes are currently exceeding RMV, generally about twice RMV values. A light to moderate prescribed burn should reduce these fuels to desired levels. Deerbrush accounts for more canopy cover (36.4 percent) in this grove than conifers (27 percent). Deerbrush is the only serious fuels problem in the Ladybug grove unit.

Summary and Conclusions

This small grove has recovered remarkably, considering recent fire history. This grove basically just needs time to grow, as species composition is good, especially in the existing seedling population. Only a few white fir possibly need to be removed where growing in tight clumps or in ladder fuel positions. With only a 27 percent conifer canopy cover and a fully stocked seedling population, no gap creation is needed. There are a few patches of fire-regenerated giant sequoia sapling and pole-sized trees that need thinning to restore reasonable growth and vigor.

Treatment of continuous areas of deerbrush to reduce the threat of wildfire spread through the grove during extreme burning conditions is the obvious restoration need. Deerbrush averages 8.5 feet in height, so mechanical treatment may be needed before prescribed burning to reduce flame height. Particular care will be needed to protect the existing seedling population during deerbrush treatment. Deerbrush reduction is also a very important need in the Ladybug grove unit to release seedlings from severe competition for moisture, sunlight and nutrients. Many of these seedlings will die, probably within the next 10 years, if deerbrush is not significantly reduced. With the current density and size of deerbrush, just one year of drought conditions could result in the loss of many seedlings.

Salt Creek Ridge Grove Unit

This grove unit is 59.4 acres in size. It is located about 1/3 mile east of the Ladybug Unit off the north side of Salt Creek Ridge within the confines of a sub-watershed that eventually drains into the East Fork of the Kaweah River. There is a large flowing spring in this grove. The grove unit ranges in elevation from 5100 to 6000 feet and is owned in its entirety by Mr. Cairns. This was once a truly beautiful grove before logging of both giant sequoia and mixed conifers in the 1940's-50's by different landowners than today. Still, there are presently 15 sequoias that range in size from 3 to 12 feet in diameter that remain after completion of the last round of logging in 1981.

Sequoia Resource:
There are **15** giant sequoias that range in size from 3 to 12 feet in diameter. There are approximately **1500** sequoias ranging in size from 4.5 to 35.9 inches in diameter which were regenerated from the 1940's-50's logging. Hand counting of 1987 fire-regenerated sequoias is not completed yet, but it is estimated that there are at least a few thousand trees competing with the deer brush. There are 64 known giant sequoia stumps found in this grove unit. There are many 25 to 35 inch diameter trees that are extremely robust, being up to 140 feet tall and only 50 years old.

Fire History:
The 1987 Case Fire crowned out over much of the grove area resulting in destruction of much of the conifer canopy in the same manner as the lower portion of the Monache Tubs Grove Unit. Much slash is found under the brush. Prescribed burning is slated for 2003.

Logging History:
Logging occurred during the 1940's-50's and during 1982 within this grove unit. Mixed confers and giant sequoias were logged during both harvests. There are 64 known large sequoias stumps found in the grove unit. Still there are forested areas where there is a good mix of incense cedar, white fir sugar pine and ponderosa pine. Black oak can be generally found in the more open areas.

Regeneration:
The lack of good sequoia seed sources and the resulting deer brush creates a thick canopy growing over many areas of this grove unit which then creates a shading problem that held back many of these young sequoia trees. Young California nutmeg trees can be found in scattered shady places within this grove. Young white fir, incense cedar, sugar pine and ponderosa pine can be found lightly scattered in many areas of the grove unit.

Reforestation:
There are no obvious sequoia plantings after the 1987 Case Fire to be found anywhere in the grove unit. Ponderosa pine has been planted along the western side of the unit below the 5400 foot elevation level and the same for the very upper portion of the unit at 6000 feet elevation. These trees appear to be healthy and in competition with each other due to close spacing.

Inventory Data

The following tables describe current conditions in terms of sampled live and dead vegetation measured on the inventory plots. FIA summary reports for all 14 plots measured in this grove unit and corresponding graphs can be found in the Appendix.

Table 1. **SPECIES COMPOSITION** (percent of total)

SPECIES	*BASAL AREA/AC.*	*TREES/AC.*
Giant sequoia	43	18
Sugar pine	9	12
White fir	31	43
Incense-cedar	12	18
Ponderosa pine	5	9

Table 2. **GROVE DENSITY and TREE STOCKING by DIAMETER CLASS** (conifers)

DIAMETER CLASS *(INCHES DBH)*	*BASAL AREA PER ACRE* *(SQ. FT.)*	*TREES PER ACRE*
1 - 4	3.6	54
5 - 10	12.5	40
11 - 14	22.7	26
15 - 20	24.7	15
21 - 28	26.2	7
29 - 38	14.3	2
39 +	0	0
TOTAL	**104.0**	**144**

Table 3. **SEEDLINGS per ACRE**

SPECIES	*NUMBER*
White fir	93
Incense-cedar	336
Giant sequoia	7
Sugar pine	7
Black oak	193
Ponderosa pine	78
CA Nutmeg	14
TOTAL	**728**

Table 4. **ANNUAL GROWTH** *(conifers 11.0 dbh and larger)*

Basal Area per Acre growth = 2.67. ft.
Cubic ft. per Acre growth = 51.2

Table 5. **VEGETATION COVER**

VEGETATION CLASS	*% CANOPY COVER**	*AVG. HEIGHT (FT.)*
Conifers	31	72
Hardwoods	14	22
Shrubs	62	7
Forbs	7	1
Grasses	1	<1
TOTAL	**115**	

* *More than 100% canopy cover indicates overlapping layers*

Table 6. **UNDERSTORY VEGETATION**

SPECIES	*% COVER*	*AVG. HEIGHT (FT.)*
Deerbrush	33.6	9.9
Bear clover	16.1	1.0
Hazelnut	4.4	7.2
Manzanita	2.9	4.0
Gooseberry	1.9	2.6
Currant	1.9	4.3
Whitethorn	0.4	5.3
Snowberry	0.1	1.0
Thimbleberry	0.4	2.0
Wild rose	0.4	1.0
TOTAL	**62.1**	

Table 7. **SNAGS per ACRE by CROWN POSITION**

GROUP	*DOMINANT*	*CODOM.*	*INTERMED.*	*SUPPRESSED*	*TOTAL*
Conifers	0.3	7.4	1.4	0	**9.1**
Hardwoods	0	0.3	0.9	0	**1.1**
TOTAL	**0.3**	**7.7**	**2.3**	**0**	**10.2**

Table 8. **DOWN LOGS per ACRE by DIAMETER CLASS**

DIA. CLASS (IN.)	*# LOGS*	*TONS/AC.*	*CU. FT./AC.*
10 – 15.9	21	2.96	311.6
16 – 23.9	10	3.69	412.2
24 +	1	14.74	1,829.9
TOTAL	**42**	**21.39**	**2,5543.7**

Table 9. **SURFACE FUELS**

DIA. CLASS (IN.)	*WEIGHT (TONS/AC.)*
Duff *	3.76
0 – 1.0	3.24
1.1 – 3.0	5.56
3.1 – 9.0	3.91
9.1 – 20.0	5.63
20.1 +	15.79
TOTAL	**37.88**

* *Duff is calculated at 9.4 tons/ac. per inch of duff depth; from Haase 1996 study of fuel weights in giant sequoia groves.*

The following tables compare key elements of current grove structure to desired structure as described by Piirto and Rogers.

Table 10. **COMPARISON of CURRENT to DESIRED GROVE STRUCTURE**

SPECIES	*CURRENT*	*DESIRED*
Giant sequoia	18% of trees, 43% of BA/ac.	10% of trees, 65% of BA/ac.
Mixed conifer	72% of trees, 57% of BA/ac.	90% of trees, 35% of BA/ac.
White fir	31% of BA/ac.	15% of BA/ac.

Table 11. **COMPARISON of CURRENT to DESIRED SURFACE FUELS** (tons per acre)

FUEL SIZE CLASS (IN.)	*CURRENT*	*DESIRED*
Duff	3.76	5 - 15
0 - 1	3.24	1 - 2
1 - 3	5.56	1 - 3
3 - 9	3.91	1 - 3
> 9	21.42	10 - 20
TOTAL	**37.88**	**18 - 43**

Discussion

Species composition (reference Table 10.) Giant sequoia is well represented in the Salt Creek grove throughout the 5 to 36 inch diameter classes. Larger giant sequoias were regenerated from the 1940-1950 logging and smaller trees from the 1987 Case Fire. Giant sequoias currently represent 18 percent of trees, slightly more than the RMV upper range of 15 percent. Giant sequoia accounts for 43 percent of total basal area per acre, slightly less than the lower RMV range of 55 percent. This grove averages only 7 giant sequoia seedlings per acre, due mainly to the heavy cover of deerbrush throughout much of this grove.

There are no obvious surpluses of any conifer diameter classes. White fir, however, accounts for 31 percent of basal area per acre, double RMV, mostly in the 1-15 inch diameter classes. About half of the white fir basal area should be removed where it is competing with other trees, especially in fuel ladder positions. After a light thinning of white fir, tree species and diameter classes appear to be reasonably balanced. Scattered patches of young trees need thinning where growth has slowed due to close spacing.

Conifer and hardwood canopy cover combined in the Salt Creek grove unit total only 45 percent. Deerbrush covers nearly 34 percent of the grove, presenting significant competition with young trees and a severe fuel problem. If a wildfire entered this grove during extreme burning conditions, the deerbrush would cause the fire to spread rapidly into the grove and into conifer crowns, as the deerbrush averages 10 feet tall.

Incense-cedar accounts for nearly half of the 728 seedlings per acre, an indication of the current light conifer canopy cover left from the 1987 Case Fire. Black oak is regenerating well in this grove, averaging 193 seedlings per acre. There are a significant number of giant sequoia and other young trees growing up through the deerbrush throughout this grove. Protection of these young trees will be important during any treatment of the deerbrush.

Surface fuels (reference Table 11.) All fuel size classes except duff are just slightly over RMV maximums, indicating a need for treatment within a few years. Surface fuel treatment needs, however, are secondary to the need for treatment of the tall, dense, continuous stands of deerbrush found throughout much of Salt Creek grove. Deerbrush averages nearly 10 feet high and will probably need mechanical treatment before burning.

Summary and Conclusions

Overall, the Salt Creek grove is healthy, tree species and sizes are generally well represented and surface fuels have not accumulated to unacceptable levels.

Giant sequoia and ponderosa pine seedlings average only 7 each per acre, so this is an indication of a general lack of seed source and/or stand conditions not favorable for tree seed germination, survival and growth. Stand treatments to favor regeneration of these two species may be needed in about 20 years.

A light thinning of white fir, mainly in the 1-15 inch diameter classes, is one of the few needed restoration treatments in the conifer component. Small scattered patches of young conifer saplings and poles also need thinning.

Treatment of deerbrush is the obvious priority need for this grove. Mechanical treatment will likely need to precede prescribed burning. Protection of young trees growing up through the deerbrush will be an important consideration.

Once deerbrush is reduced in height and density, a light to moderate prescribed burn would reduce surface fuels to lower RMV ranges.

Coffee Pot Grove Unit

This grove unit is 47.3 acres in size. It is located within a sub-watershed along the north side of Salt Creek Ridge that eventually drains into the East Fork of the Kaweah River. There is a flowing spring system found in this grove. The Coffee Pot grove unit is located to the east of the other five grove units. It is about 1/3 mile from the Salt Creek Ridge Unit and ½ mile from the nearby Sequoia-Kings Canyon National Park. Salt Creek Ridge then runs eastward and becomes steeper and drier as it continues up onto the 9000 foot Homers Nose peak which is located in the Park. There are no other grove units higher up on this ridge. The Coffeepot Grove unit ranges in elevation from 5500 to 6100 feet. The upper portion in Section 1 and a small portion at the very bottom are located on BLM lands, while the rest is owned by Mr. Cairns. Much of the private portions were logged by previous owners during the 1940's and 50's of both mixed conifers and giant sequoias, while the BLM portions were cut for mixed conifers and a few large sequoias. The largest Case Mountain sequoia stump found on BLM is located in this grove and it measured 51.3 feet in circumference. This could have been the largest tree found on BLM land anywhere at that time. Now, a stack of split fence posts sit atop this stump, cut over 50 years ago. It appears that many of the large giant sequoias cut during that early period were made into fence posts.

Sequoia Resource:
There are **18** giant sequoias that range in size from size from 3 to 14 feet in diameter. Most of the larger sequoias are found on BLM making a total of **7** trees, while there are **11** trees located on the private land. There are **324** sequoias located on BLM and **854** sequoias on private land that range in size from 4.5 to 35.9 inches in diameter. Many of the more vigorous trees are up to 140 feet in height. These trees were regenerated from logging activities from over 50 years ago. Probably over 90 percent of all the sequoias are in this 50-year old age class. There are 67 sequoia stumps which were cut during the 1940's-50's logging period. Included in the stump total are approximately 18 smaller 3 to 5 foot diameter stumps cut during 1982 by previous landowners who also cut mixed conifers. The high density of stumps in this grove unit attests to the former beauty of numerous sequoia monarch trees once found throughout this once tightly packed grove. There are only small areas of 1987 fire-regenerated sequoias to be found due to lack of good seed sources.

Fire History:
Only about 60 percent of the grove area burned in 1987. The lower portion of this grove unit is now heavily cloaked with thick stands of deer brush. Still there are some young healthy sequoias to be found in the brush fields. Incense-cedar, white fir, sugar pine and ponderosa pine saplings can also be found in the unit. There is also California nutmeg regeneration as a result of the 1987 fire. Portions of the grove not burned by the fire have areas of high density slash and trees closely spaced together. Prescribed fire is planned for the future.

Logging History:
This grove unit is no different than the other five units with respect to logging event time frames and species harvested. Approximately 90 percent of the grove unit was logged at one time or another. The 1940's-50's logging efforts were much more intensive than those of 1982. Mixed conifers and giant sequoia were the target species. Still, there is a good mix of those species to be found today. Black oak can be found generally in the more open areas.

Regeneration:
Sapling-sized giant sequoias are found in a few small scattered locations where the 1987 fire burned portions of the grove. Rapid establishment of dense stands of deer brush has caused many of these trees to suffer from excessive shading. Mixed conifer saplings can also be found in many places.

Reforestation:
There are no known tree plantings in this grove unit.

Inventory Data

The following tables describe current conditions in terms of sampled live and dead vegetation measured on the inventory plots. FIA summary reports for all 12 plots measured in this grove unit and corresponding graphs can be found in the Appendix.

Table 1. **SPECIES COMPOSITION** (percent of total)

SPECIES	*BASAL AREA/AC.*	*TREES/AC.*
Giant sequoia	4	6
Ponderosa pine	6	14
Sugar pine	5	1
White fir	55	50
Incense-cedar	30	29

Table 2. **GROVE DENSITY and TREE STOCKING by DIAMETER CLASS** (conifers)

DIAMETER CLASS *(INCHES DBH)*	*BASAL AREA PER ACRE* *(SQ. FT.)*	*TREES PER ACRE*
1 - 4	6.7	329
5 - 10	44.6	141
11 - 14	41.5	46
15 - 20	47.3	27
21 - 28	45.6	16
29 - 38	10.0	2
39 +	3.2	<1
TOTAL	**198.9**	**561**

Table 3. **SEEDLINGS per ACRE**

SPECIES	*NUMBER*
White fir	408
Incense-cedar	575
Pacific dogwood	175
Sugar pine	42
Black oak	167
Ponderosa pine	25
CA nutmeg	25
TOTAL	**1,417**

Table 4. **ANNUAL GROWTH** *(conifers 11.0 dbh and larger)*

Basal Area per Acre growth = 3.86sq. ft.
Cubic ft. per Acre growth = 109.9

Table 5. **VEGETATION COVER**

VEGETATION CLASS	*% CANOPY COVER **	*AVG. HEIGHT (FT.)*
Conifers	80	55
Hardwoods	15	28
Shrubs	24	8
Forbs	2	1
Grasses	1	<1
TOTAL	**122**	

** More than 100% canopy cover indicates overlapping layers*

Table 6. **UNDERSTORY VEGETATION**

SPECIES	*% COVER*	*AVG. HEIGHT (FT.)*
Deerbrush	14.6	11.9
Bear clover	2.1	1.0
Hazelnut	1.5	5.4
Gooseberry	2.5	2.5
Currant	0.4	3.0
Snowberry	0.6	1.0
Wild rose	1.3	1.0
Whitethorn	0.4	10.0
Thimbleberry	0.4	1.0
Blackberry	0.2	1.5
Whiteleaf manzanita	0.1	5.0
TOTAL	**41.0**	

Table 7. **SNAGS per ACRE by CROWN POSITION**

GROUP	*DOMINANT*	*CODOM.*	*INTERMED.*	*SUPPRESSED*	*TOTAL*
Conifers	0.7	5.3	22.5	0	**28.5**
Hardwoods	0	1.0	0.7	0	**1.7**
TOTAL	**0.7**	**6.3**	**23.2**	**0**	**30.2**

Table 8. **DOWN LOGS per ACRE by DIAMETER CLASS**

DIA. CLASS (IN.)	*# LOGS*	*TONS/AC.*	*CU. FT./AC.*
10 – 15.9	24	2.85	302.9
16 – 23.9	13	3.99	443.8
24 +	10	58.25	6,592.5
TOTAL	**47**	**65.09**	**7,339.2**

Table 9. **SURFACE FUELS**

DIA. CLASS (IN.)	*WEIGHT (TONS/AC.)*
Duff *	10.34
0 – 1.0	3.51
1.1 – 3.0	6.42
3.1 – 9.0	6.65
9.1 – 20.0	6.70
20.1 +	58.37
TOTAL	**91.98**

* *Duff is calculated at 9.4 tons/ac. per inch of duff depth; from Haase 1996 study of fuel weights in giant sequoia groves.*

The following tables compare key elements of current grove structure to desired structure as described by Piirto and Rogers.

Table 10. **COMPARISON of CURRENT to DESIRED GROVE STRUCTURE**

SPECIES	*CURRENT*	*DESIRED*
Giant sequoia	6% of trees, 4% of BA/ac.	10% of trees, 65% of BA/ac.
Mixed conifer	94% of trees, 96% of BA/ac.	90% of trees, 35% of BA/ac.
White fir	55% of BA/ac.	15% of BA/ac.

Table 11. **COMPARISON of CURRENT to DESIRED SURFACE FUELS** (tons per acre)

FUEL SIZE CLASS (IN.)	*CURRENT*	*DESIRED*
Duff	10.34	5 - 15
0 - 1	3.51	1 - 2
1 - 3	6.42	1 - 3
3 - 9	6.65	1 - 3
> 9	65.07	10 - 20
TOTAL	**91.98**	**18 - 43**

Discussion

Species composition (reference Table 10.) Giant sequoia represents 6 percent of all trees in this grove, but only 4 percent of basal area per acre, well below the RMV desired basal area per acre of 65 percent. This indicates the presence of very few large giant sequoia trees.

Mixed conifer represents 94 percent of all trees, near the upper limit of RMV. Mixed conifer basal area per acre is 96 percent of the total, compared to mid-range RMV of 35 percent. There is an obvious surplus of mixed conifer in the Coffee Pot grove, further demonstrated by white fir representing 55 and incense-cedar 30 percent of basal area per acre. This excess is spread mostly over the 5-14 inch diameter classes (Table 2). These are probably a combination of logging and fire regenerated trees.

The Coffee Pot grove is similar to the Monache Tubs grove. The 1987 Case Fire burned intensely in the lower portions of these groves. The lower slopes are now occupied by dense, continuous stands of deerbrush.

Conifer regeneration is the best of all grove units with an average of 1,417 seedlings per acre, but with very few giant sequoia seedlings found on any of the plots. Conditions in the dense conifer stands are not favorable for regeneration of shade intolerant species such as pines and giant sequoia. Considering basal area averaging nearly 200 sq. ft. per acre and conifer cover averaging 80 percent, most conifer stands are overstocked and in need of thinning.

The Coffee Pot grove, referencing Table 2, has a more typical tree size representation than other Case Mountain groves, of an unevenage distribution. A surplus of small trees exists in the 1-10 inch diameter classes, while there are relatively few large trees in the 29 inch and larger diameter classes.

Surface fuels (reference Table 11). Surface fuels in the Coffee Pot grove significantly exceed RMV levels in all size classes except duff. The greater than 9 inch class is especially heavy, about 4 times the mid-range level. Most of this excess is in the 24 inch and larger down log class, an obvious result of the 1987 Case Fire. Fuels in the 0-9 inch classes are approximately double the upper limit RMV level. The large, continuous, dense stands of deerbrush on the lower slopes places this grove at very high risk of loss to wildfire during extreme burning conditions. The Coffee Pot grove should have high priority for fuel treatment.

Summary and Conclusions

The Coffee Pot grove has the most dense conifer stands (nearly 200 sq. ft. of basal area per acre) and by far the heaviest fuel loading at 92 tons per acre. Seedlings here are also much higher than the other Case Mountain groves at 1,417 per acre. Conifer stands are mostly overstocked, mainly in the small and intermediate size classes. About one third of the basal area per acre should be removed in these dense stands to restore reasonable growth and vigor. This should be accomplished by a combination of thinning from below, mainly in the 5-14 inch diameter classes, and by creating canopy gaps to favor pine and giant sequoia regeneration. Overstocked conditions of these conifer stands are inviting tree stress from severe competition for moisture, sunlight and nutrients. Severe tree stress can lead to increased mortality from forest insects and diseases. Stand density related mortality may already be evident, as this grove averages 30 snags per acre, significantly more than any of the other Case Mountain groves.

Restoration activities in this grove may require more than one entry. Existing fuels are already exceeding RMV. Any project generated fuels would add to these significantly, so separate treatments will most likely be needed. Prescribed burning is not recommended in this grove without reducing existing fuels by mechanical methods first, due to the high volume of existing fuels and dense conifer and deerbrush stands.

Deerbrush stands should be treated in a similar manner as recommended for the Monache Tubs grove. Deerbrush in the Coffee Pot grove averages nearly 12 feet in height. This is probably much too tall to consider burning before a mechanical treatment, due to the flame lengths that would result. There are some giant sequoia trees scattered in with the deerbrush. Protection of these and other conifers during deerbrush treatment will be important.

Case Mountain Grove Complex Summary

The following table displays important structural elements of all six Case Mountain grove units so groves can be compared to each other.

STRUCTURAL ELEMENT	*CASE*	*NUTMEG*	*MONACHE*	*SALT CR.*	*LADYBUG*	*COFFEE POT*
GS Trees/ac.	45	27	**137**	26	**16**	34
BA/ac.	178	191	124	**104**	143	**199**
Trees/ac.	179	450	253	144	**81**	**561**
Seedlings/ac	765	936	**446**	728	643	**1,417**
BA/ac. growth	2.95	**4.44**	3.68	**2.67**	3.47	3.86
Cu. ft./ac. growth	76.2	89.1	**41.7**	51.2	94.6	**109.9**
% conifer cover	51	79	46	31	**27**	**80**
% shrub cover	**14**	16	43	**62**	41	24
Snags/ac.	**7.3**	8.6	19.0	10.2	12.1	**30.2**
Down logs/ac.	**31**	38	34	42	**47**	**47**
Fuel tons/ac.	45.26	39.03	60.66	**37.88**	38.97	**91.98**

Highest value
Lowest value

Management Recommendations

Fire and Fuels. Protection of groves from catastrophic wildfire should probably be the highest priority for grove management. ***Case Mountain giant sequoia groves are likely more at risk of fire burning into them from below than from ignitions within the groves,*** considering dense, continuous stands of chaparral on slopes below the groves. While ignitions from lightning are probably more common on exposed ridges within and above the groves, human ignition sources are more common near the base of Case Mountain from

ranching and recreational activities. Very high consideration, then, should be given to evaluation of fuels on BLM lands on the entire Case Mountain block, not just within the giant sequoia groves.

Mr. Cairns and the other private landowners on Case Mountain should be made aware of and encouraged to participate in NRCS and CA Dept. of Forestry assistance programs. NRCS has also recently established a Resource Conservation and Development (RC&D) program locally that could significantly benefit the Case Mountain private landowners and help fund projects on their lands consistent with the BLM management strategy. The NRCS District Conservationist in Visalia and CDF Cooperative Management Forester at Tulare Ranger Unit in Visalia should be contacted for details on these programs.

Wildfire suppression has allowed stands of chaparral to remain unburned for decades. These stands are now so dense, continuous and tall that some mechanical treatment will likely be needed before prescribed burning could be done safely. A strategic system of fuelbreaks and treatment of small, logical stands of chaparral may be a good approach, creating a varied fuel mosaic.

Large stands of deerbrush and other shrubs on lower grove slopes, especially in Coffee Pot, Monache Tubs, and Nutmeg groves, are a major concern for spread of fire into and through groves under extreme burning conditions. While treatment of entire deerbrush stands in and near these groves would require a large budget and several years to accomplish, a strategy similar to that used in the Urban Intermix areas on the Sequoia National Forest as directed by the Sierra Nevada Forest Plan Amendment, would be a good idea to consider. Defense Zones (similar to wide fuelbreaks) would be constructed through the brush fields at the grove perimeters. Threat Zones (brush on slopes below the groves) are treated in an irregular mosaic pattern. Sequoia NF Fire Management personnel could assist with this concept and design for Case Mountain.

Prescribed burning currently planned in and near Case Mountain giant sequoia groves should be reconsidered within the context of an overall fuels management strategy. Some areas may need mechanical treatment prior to burning for control of flame length so burning can be done safely without undue risk of losing control of the burn.

Grove Structure. Elements of existing grove structure and how they compare to RMV have been discussed in detail for each grove in the previous sections of this report.

Regeneration of conifer species is not a major concern in any of the groves, as regeneration pulses have been created by the 1928 burn, logging of about 50 years ago, and the 1987 Case Fire. Distribution of regeneration, however, is not even and much of it, including patches of small giant sequoia trees, needs thinning to restore reasonable growth and vigor. ***Thinning is a low-cost, high return practice that can be done independently of other restoration and planning activities.*** Thinning these patches could be expanded to include removal of ladder fuels where other conifers are growing into the crowns of larger giant sequoia trees. Thinning and ladder fuel removal is needed to some extent in all groves. Nutmeg and Coffee Pot groves are priorities for ladder fuel treatment. The Case and Monache Tubs groves have a significant need for thinning patches of giant sequoia pole-sized trees.

Giant sequoia and pine regeneration within the more dense conifer stands is an important long-term concern. Where past logging and wildfire have not reduced stand density, giant sequoia and pine species are currently not regenerating. Tree growth in these dense stands has slowed. Evidence of stand density-related mortality is showing up in the Coffee Pot grove which has the highest overall need for thinning. This grove averages over 30 snags per acre. Removal of at least half of these snags should be considered because of the fuel and safety issues associated with them. Only about 8 snags per acre are needed for

spotted owls and other cavity nesting and snag dependent wildlife species. The Nutmeg grove also has dense stands in need of treatment. A combination of canopy gap creation and thinning from below will restore conditions favorable for regeneration of shade intolerant species in the gaps. Reasonable growth and vigor will be restored to the thinned conifer stands. Heavy brush patches within groves could be treated concurrently, aiding in reduction of wildfire spread potential while reducing competition with young trees for soil moisture, nutrients and sunlight, along with treatment of existing and project created fuels.

Conclusion

The Case Mountain giant sequoia grove complex is a truly unique resource on BLM managed lands. Fire, logging, ownership and management history have created a fairly complex set of existing conditions in and near this group of giant sequoia groves. Decades of wildfire suppression has created ecologically unnatural conditions on Case Mountain, similar to conditions in conifer stands throughout the Sierra Nevada range. The Case Fire of 1987 offers a preview of what can happen with a wildfire ignition in these fuel-laden stands during extreme burning conditions. Case Mountain is located in the lower elevational range of giant sequoia with large areas of chaparral just below the groves. Threat of wildfire burning into the groves from below is therefore the most serious concern.

Now that a number of recent studies have been completed for Case Mountain, a comprehensive management planning process (NEPA) leading to an EA or EIS and Case Mountain Management Plan is the logical next step, while some small projects such as thinning and ladder fuel reduction could certainly be done concurrently with the overall planning process.

This report has offered grove structure management recommendations based mainly on accepted silvicultural methods and practices, and should be used as one of many references in the planning process. As a custodian of public lands, BLM must also consider agency policy and protocols, public involvement and budget priorities in the overall context of managing the natural resources on Case Mountain.

The "Living Laboratory" concept has been embraced for Case Mountain management, which would offer all public agency managers of giant sequoia groves a chance to participate, most effectively through the existing Giant Sequoia Cooperative. This idea should be pursued through the NEPA planning process. Expertise of local research scientists, giant sequoia and other natural resource specialists with experience in managing giant sequoia groves will be needed to assist BLM in design of the best possible strategy for the management of Case Mountain.

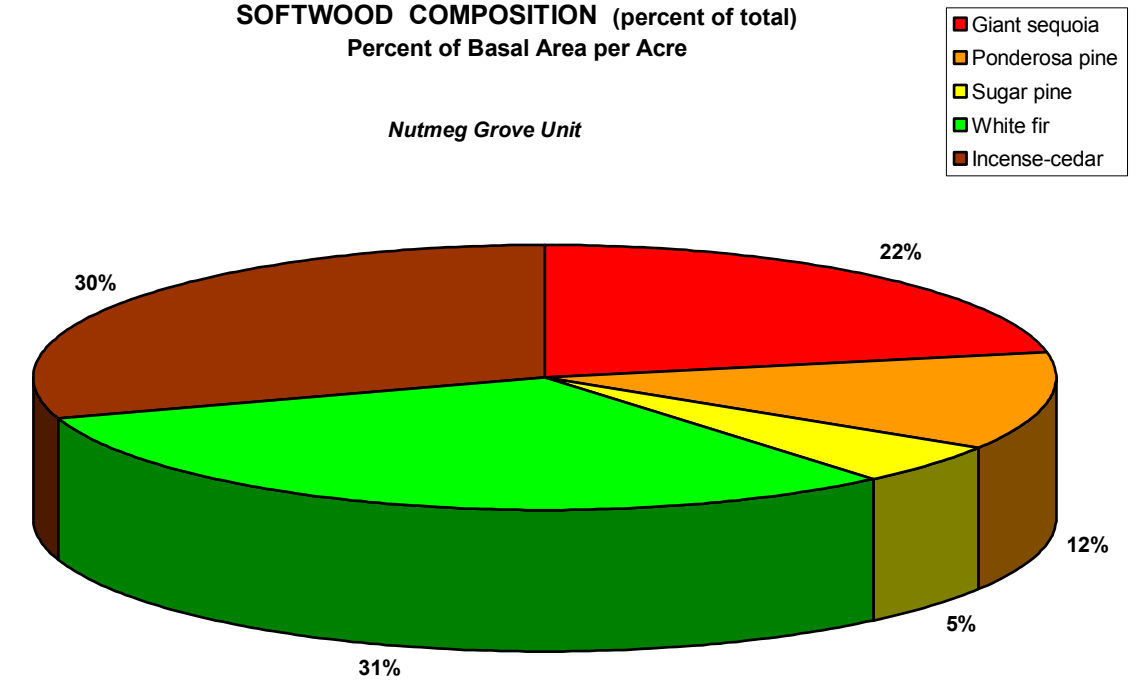
A p p e n d i x

- **Maps**
- **Graphs**
- **Photo Galleries**
- **Inventory Summary Reports**
- **Original Plot Data Field Sheets**

Nutmeg

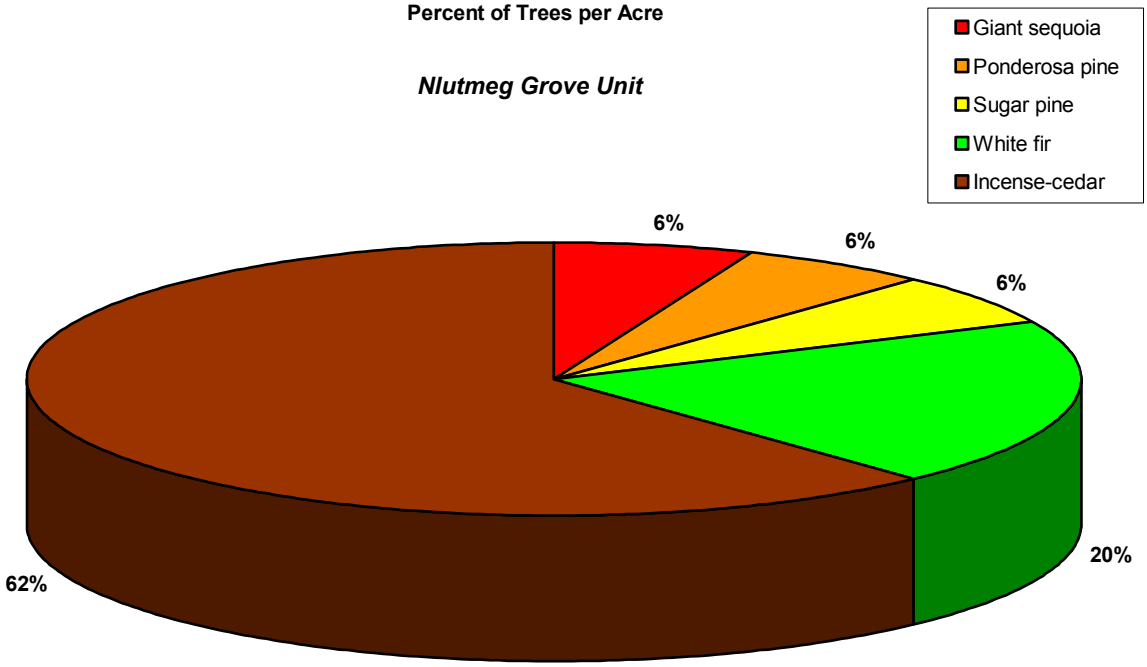
SOFTWOOD COMPOSITION (percent of total)
Percent of Basal Area per Acre

Nutmeg Grove Unit

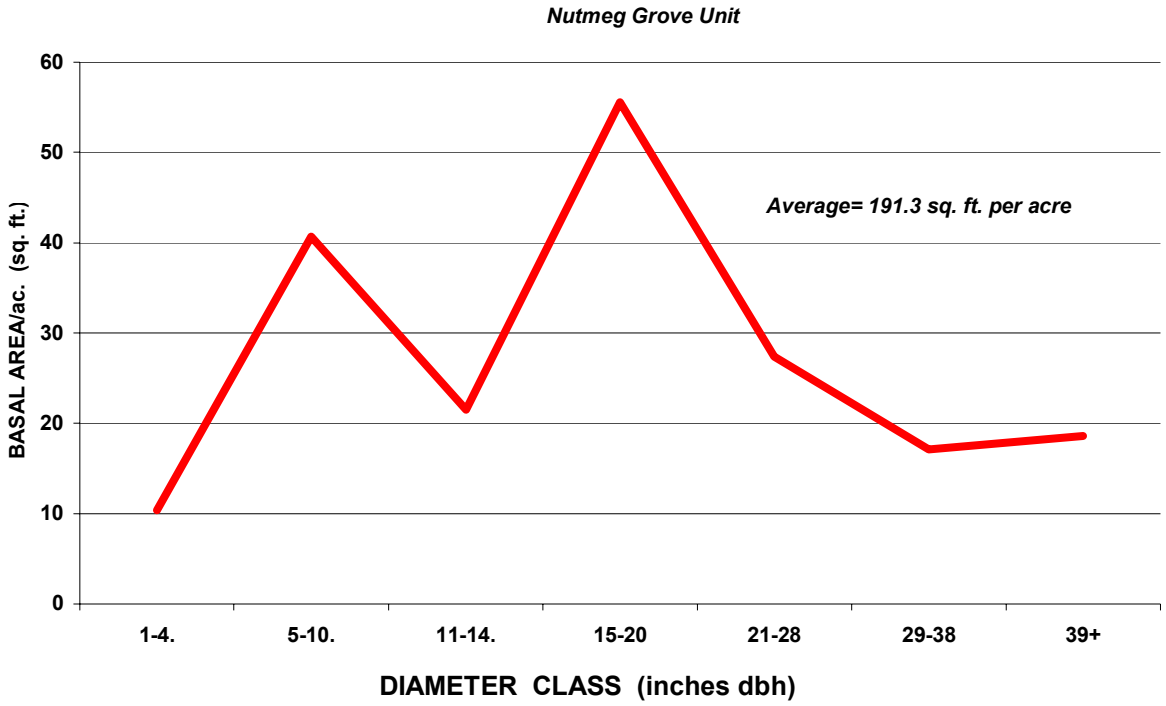


SOFTWOOD COMPOSITION (percent of total)
Percent of Trees per Acre

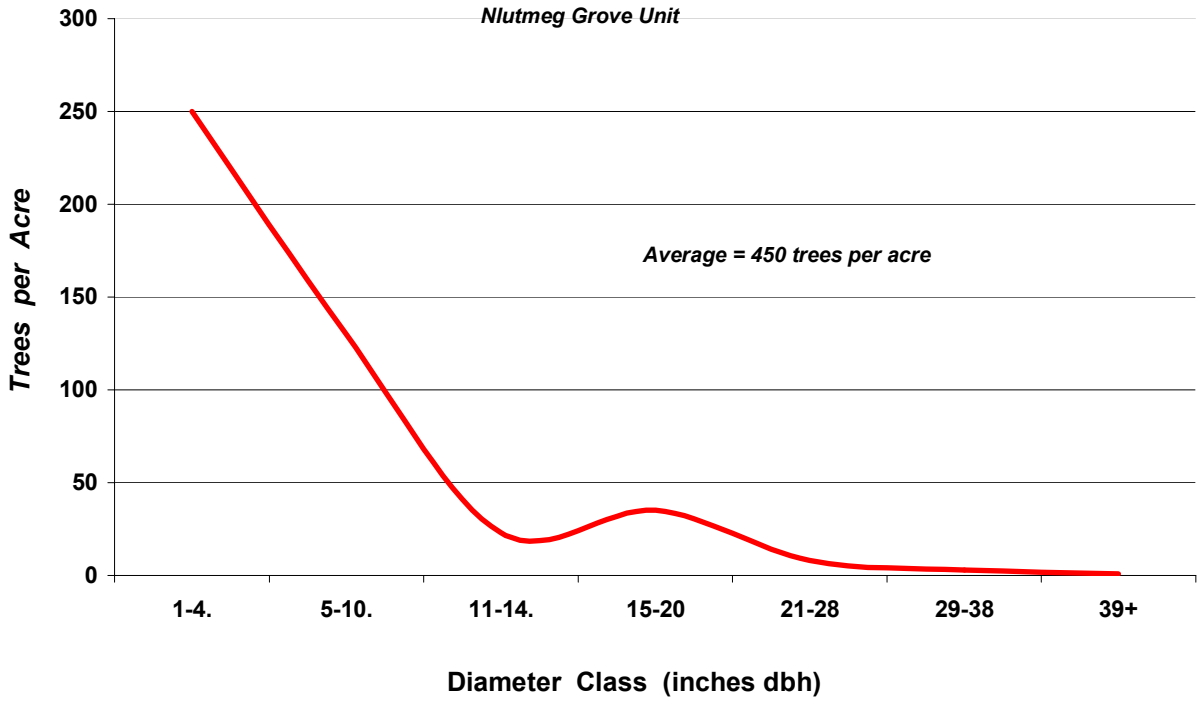
Nlutmeg Grove Unit



GROVE DENSITY by DIAMETER CLASS (conifers)
Basal Area per Acre

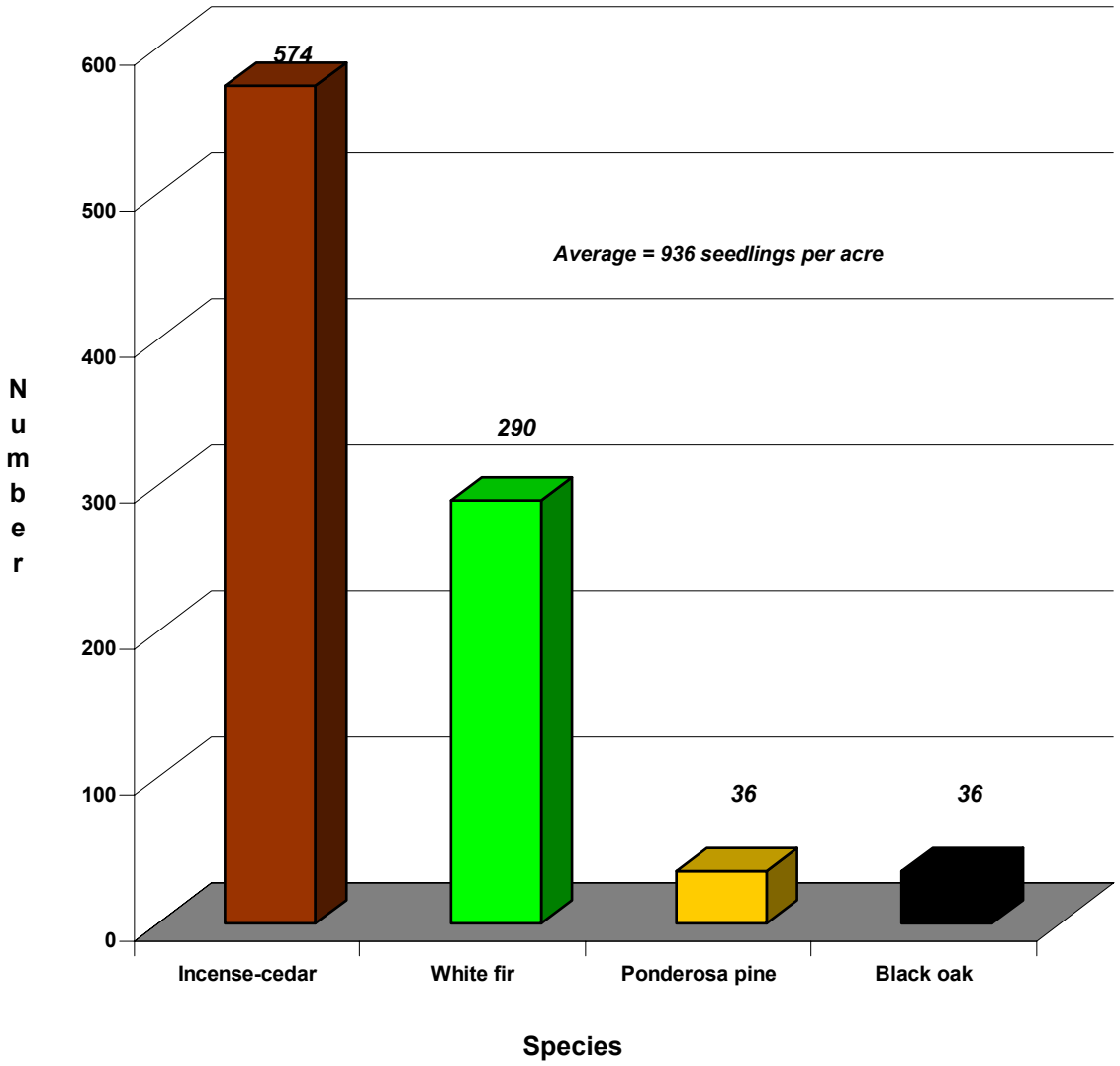


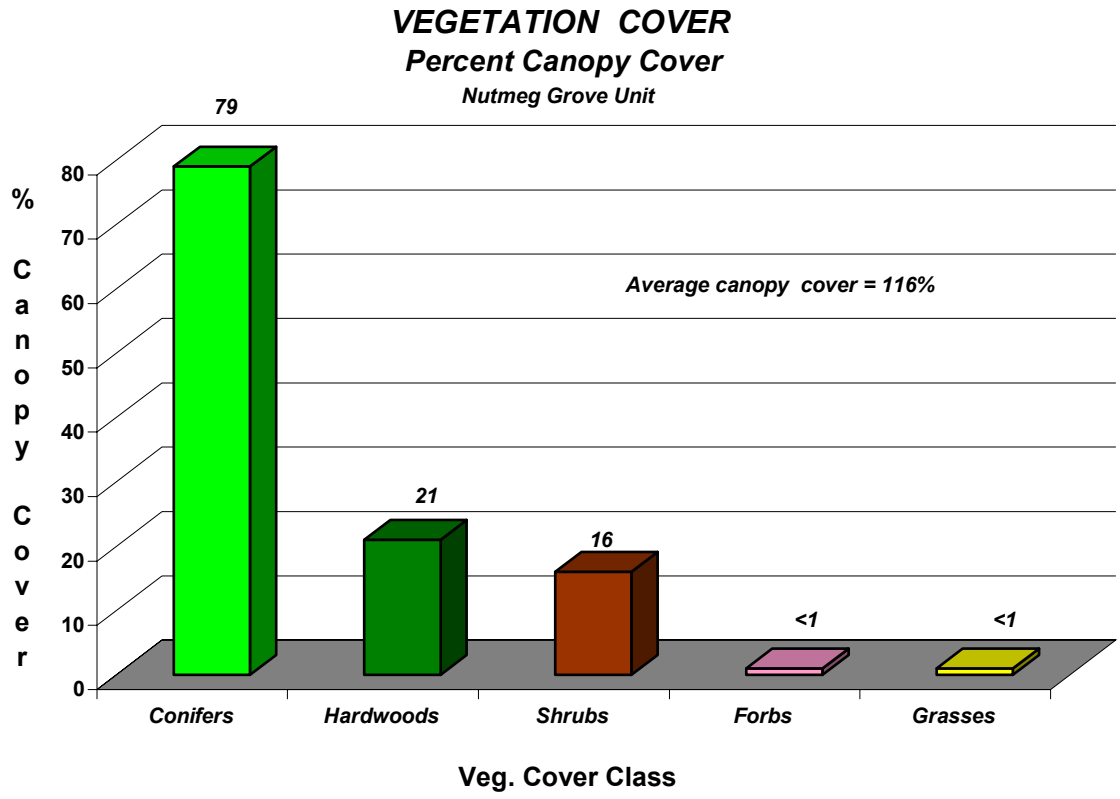
CONIFER STOCKING
Trees per Acre by Diameter Class

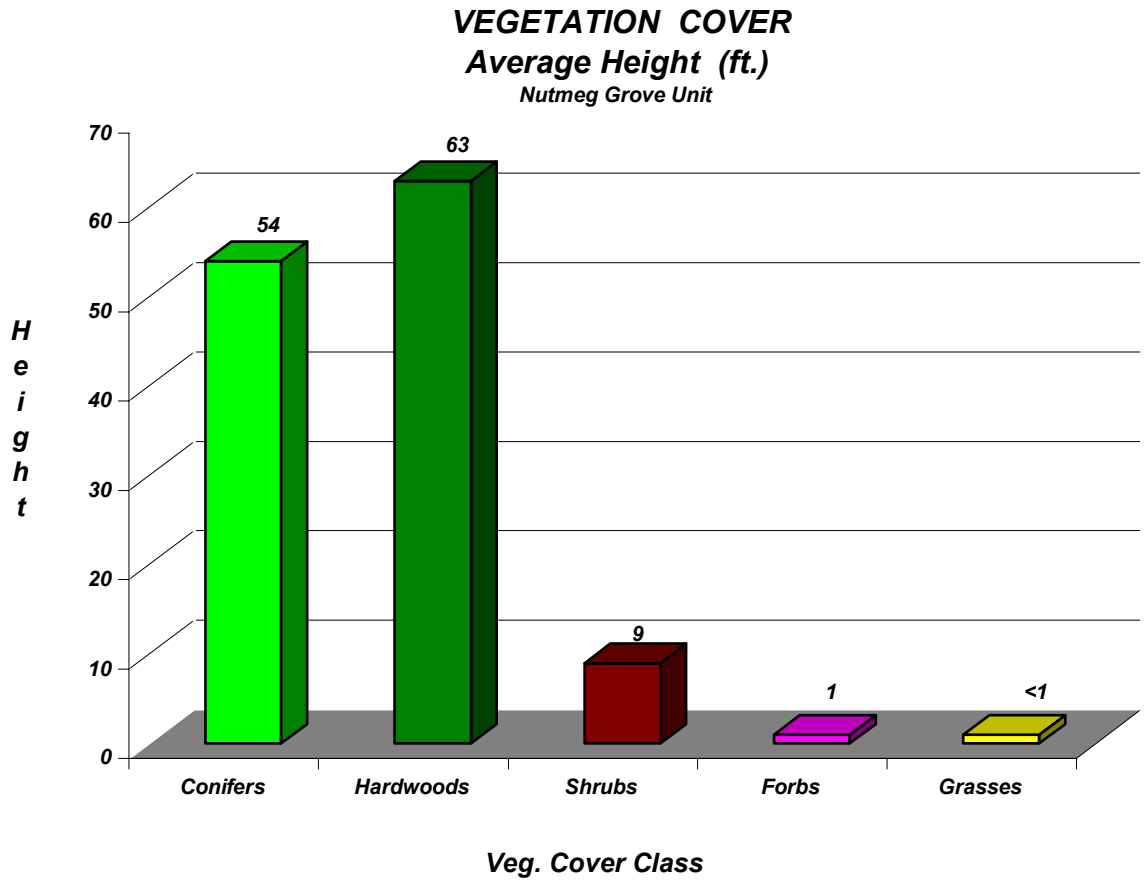


SEEDLINGS per ACRE

Nutmeg Grove Unit



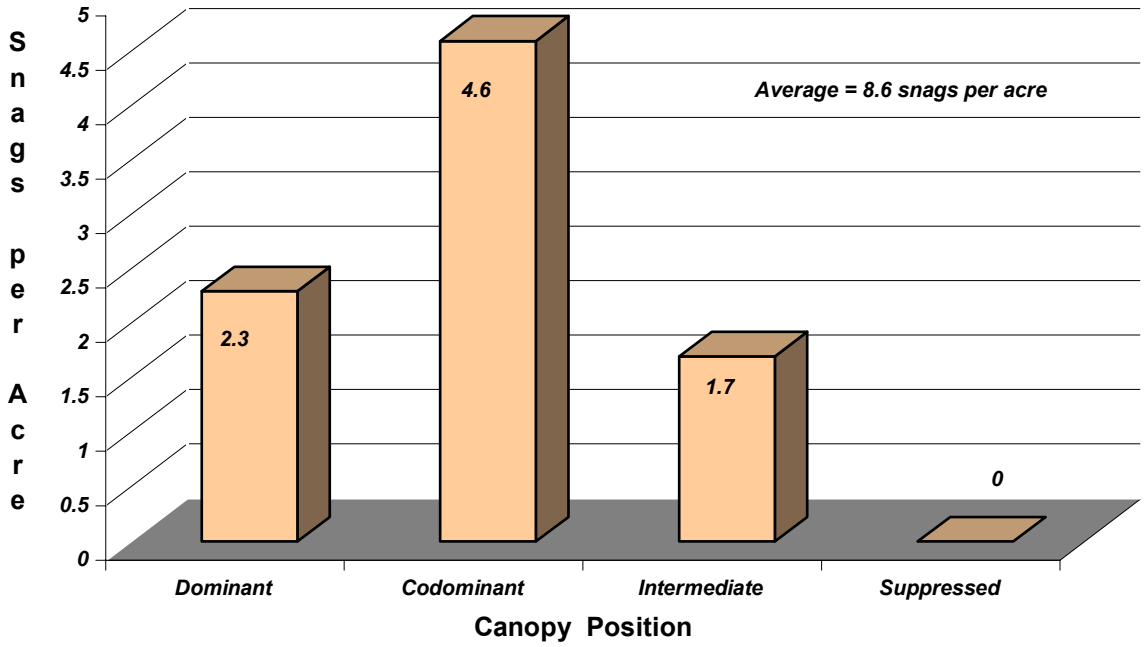

VEGETATION COVER
Percent Canopy Cover
Nutmeg Grove Unit
% Canopy Cover
0
10
20
30
40
50
60
70
80
79
21
16
<1
<1
Average canopy cover = 116%
Conifers
Hardwoods
Shrubs
Forbs
Grasses
Veg. Cover Class


VEGETATION COVER
Average Height (ft.)
Nutmeg Grove Unit
Height
0
10
20
30
40
50
60
70
54
63
9
1
<1
Conifers
Hardwoods
Shrubs
Forbs
Grasses
Veg. Cover Class

SNAGS

Average Density by Canopy Position

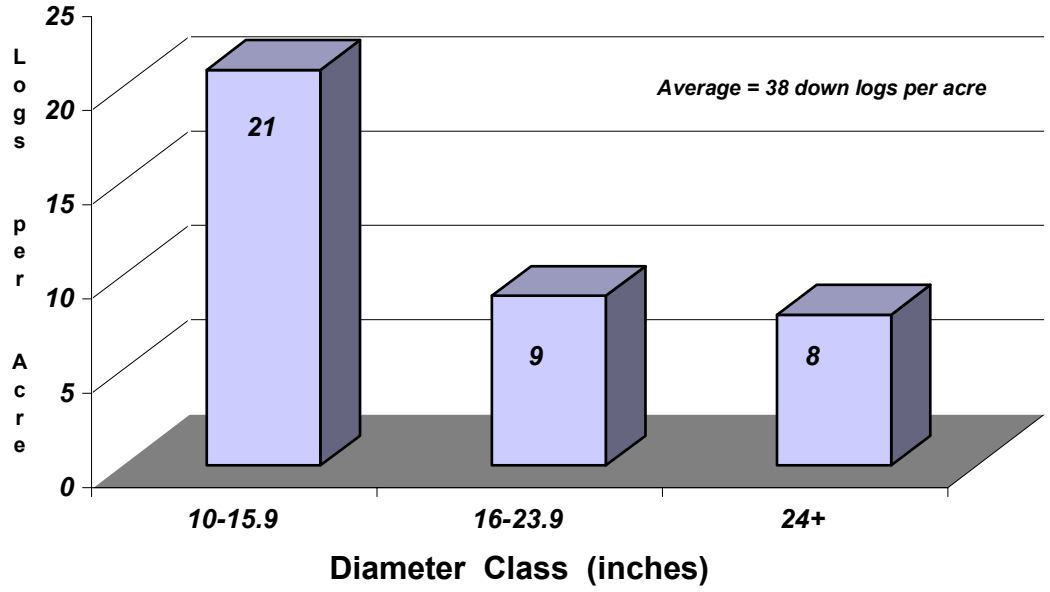
Nutmeg Grove Unit



DOWN LOGS

Average Density per Acre

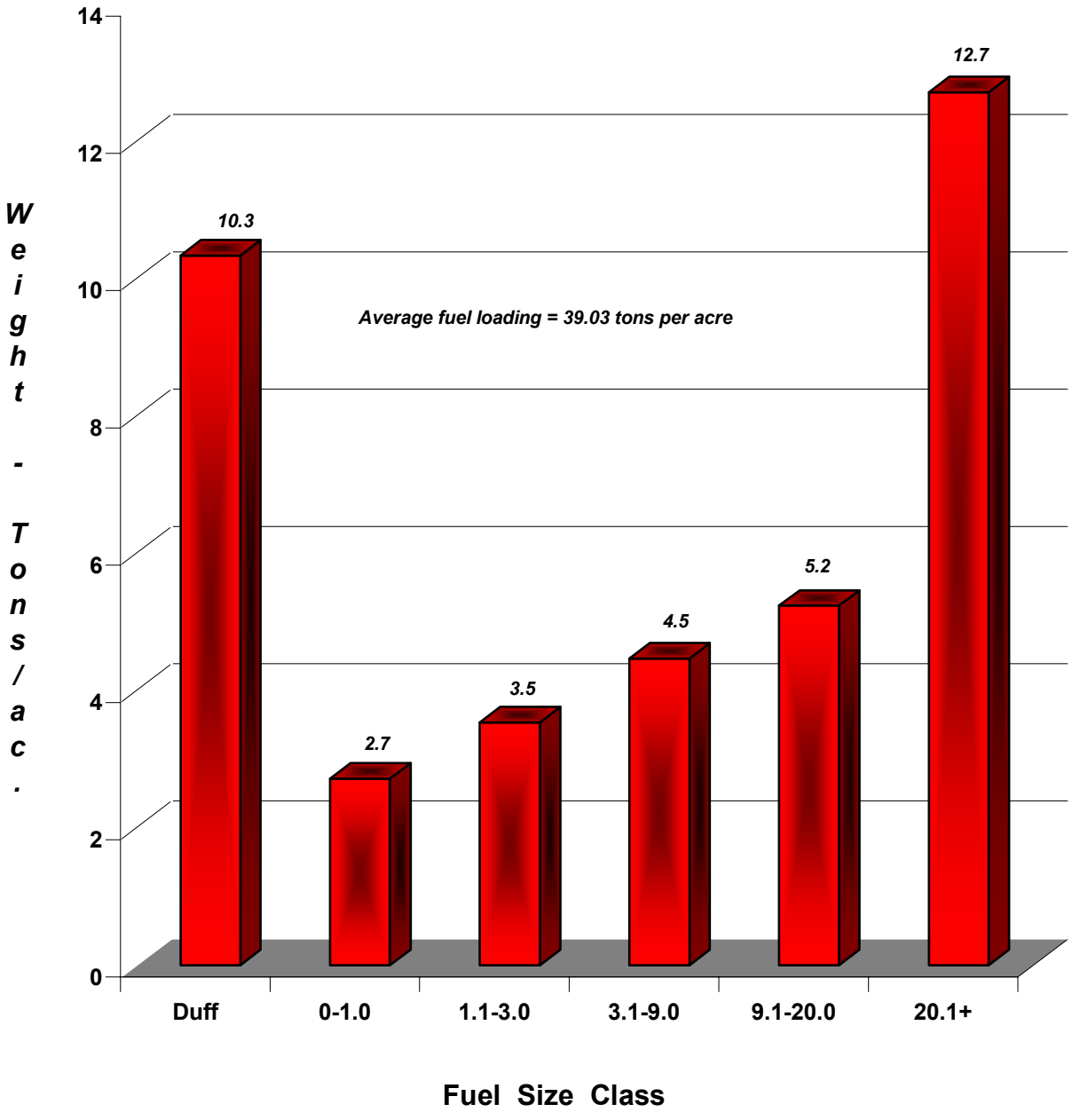
Nutmeg Grove Unit



SURFACE FUELS

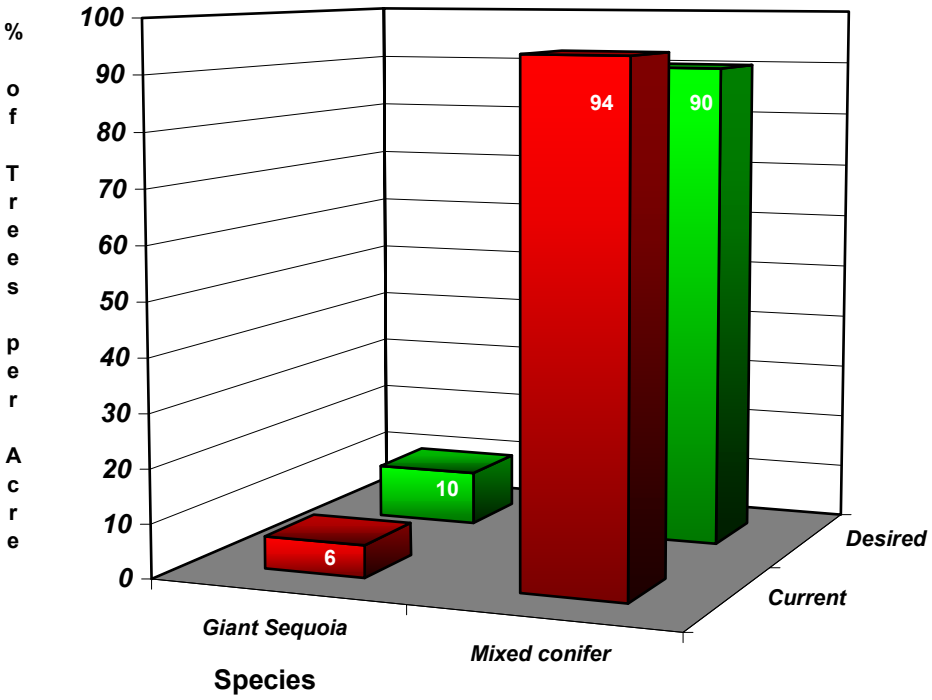
Fuel Loading, Tons per Acre

Nutmeg Grove Unit



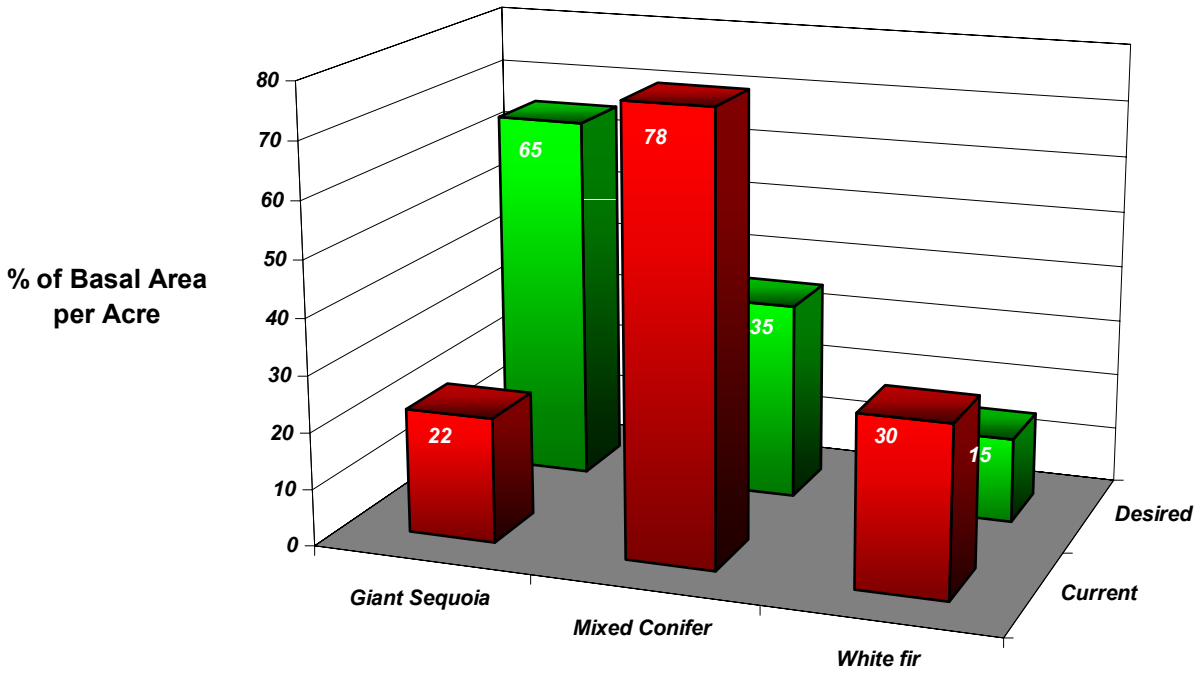
COMPARISON of CURRENT to DESIRED
Percent of Trees per Acre

Nutmeg Grove Unit



COMPARISON of CURRENT to DESIRED
Percent of Basal Area per Acre

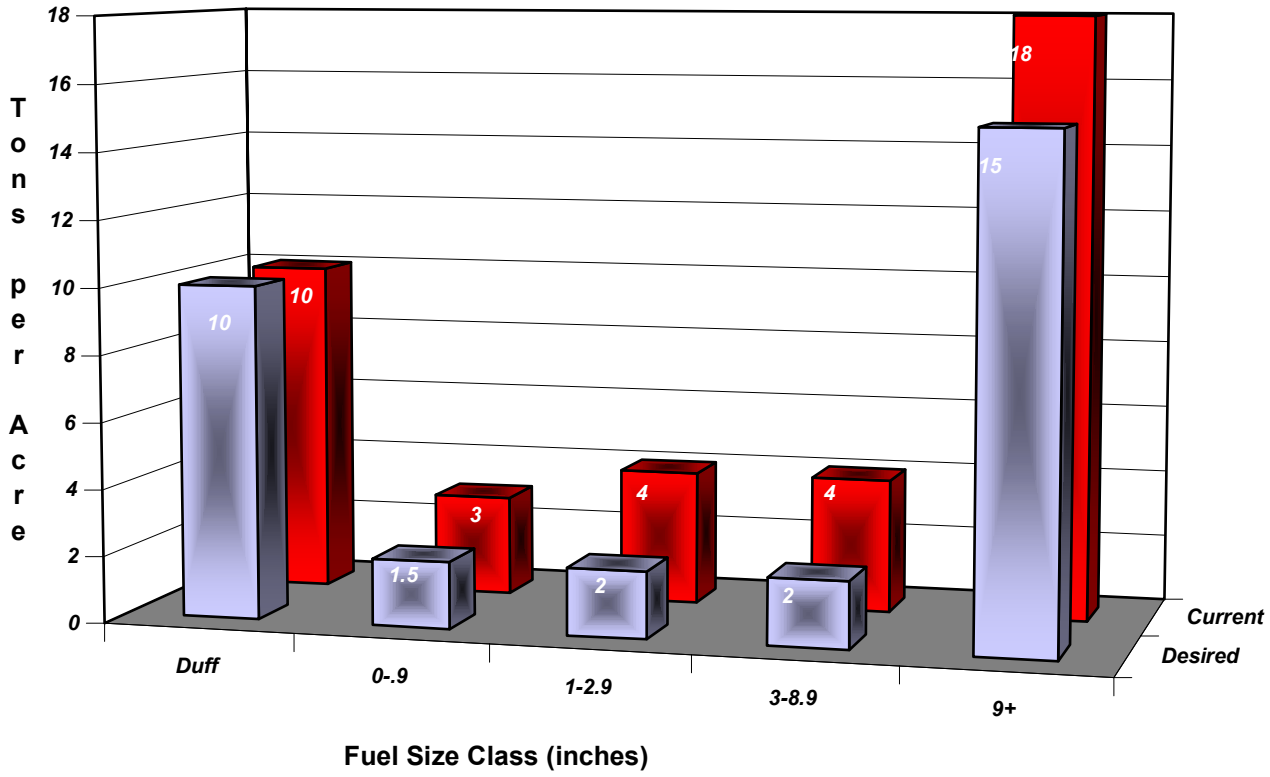
Nutmeg Grove Unit



COMPARISON of CURRENT to DESIRED SURFACE FUELS

Fuel Loading, Tons per Acre

Nutmeg Grove Unit



Current fuel loading = 39 tons per acre

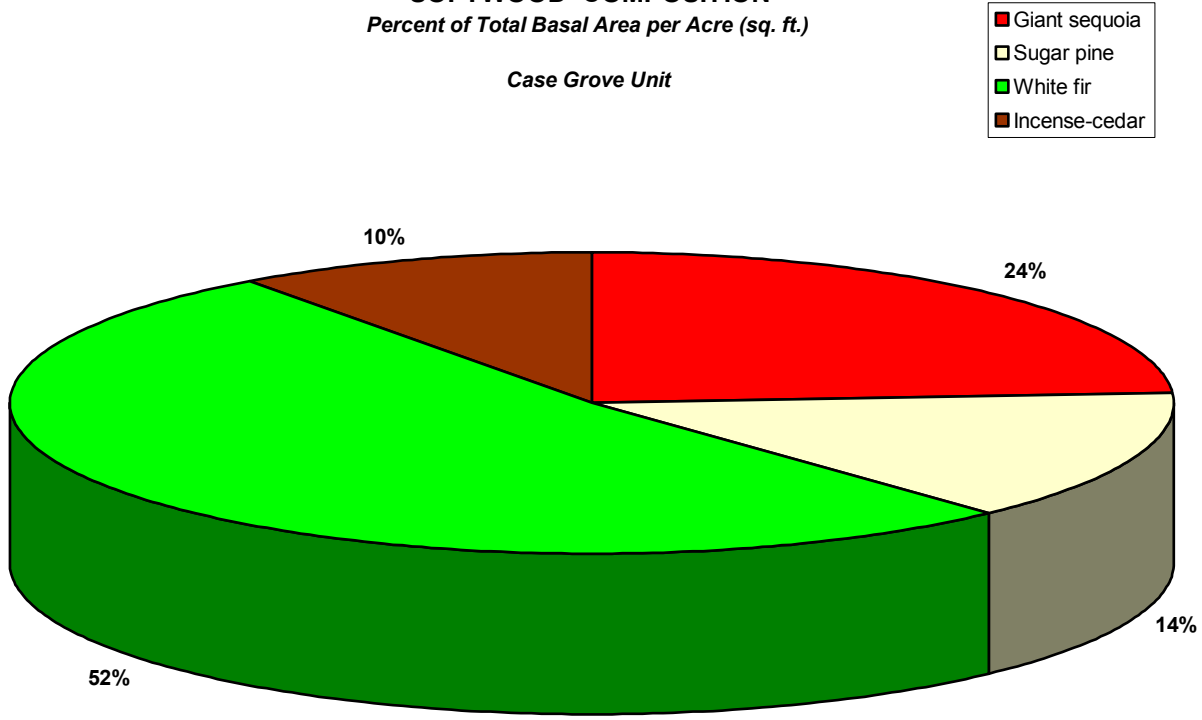
Desired fuel loading = 18 - 43 tons per acre

Case

SOFTWOOD COMPOSITION

Percent of Total Basal Area per Acre (sq. ft.)

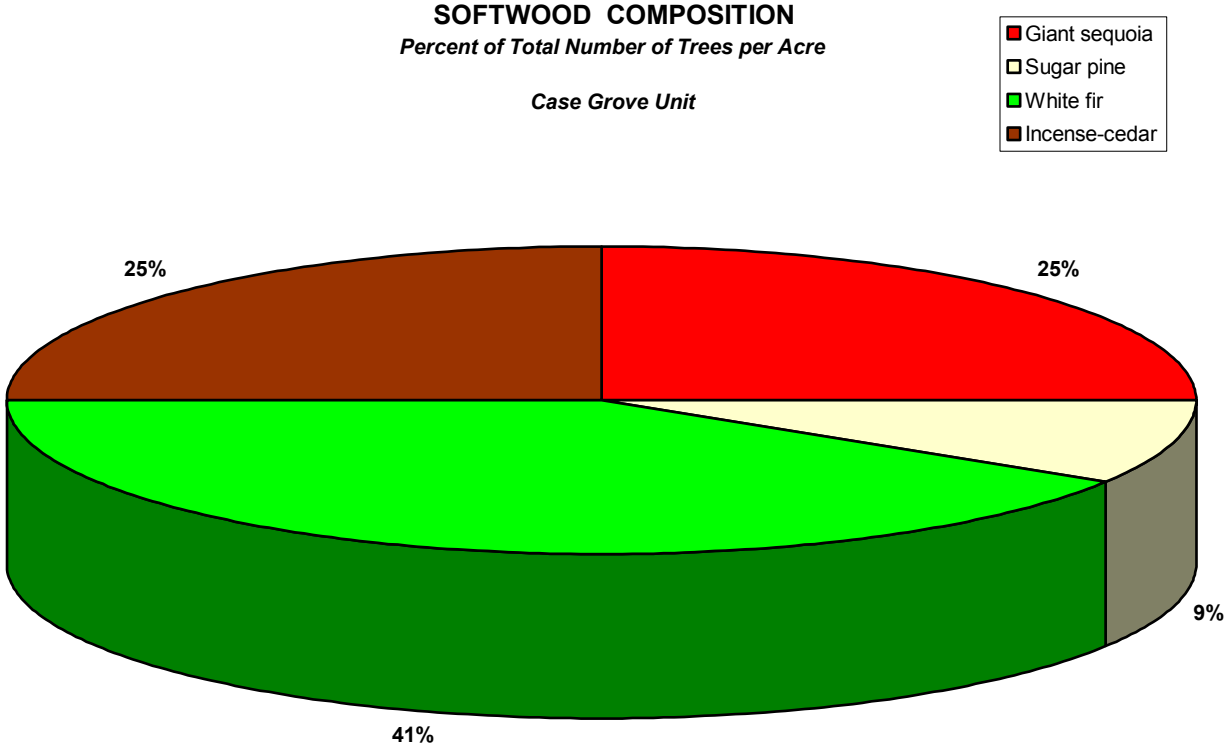
Case Grove Unit



SOFTWOOD COMPOSITION

Percent of Total Number of Trees per Acre

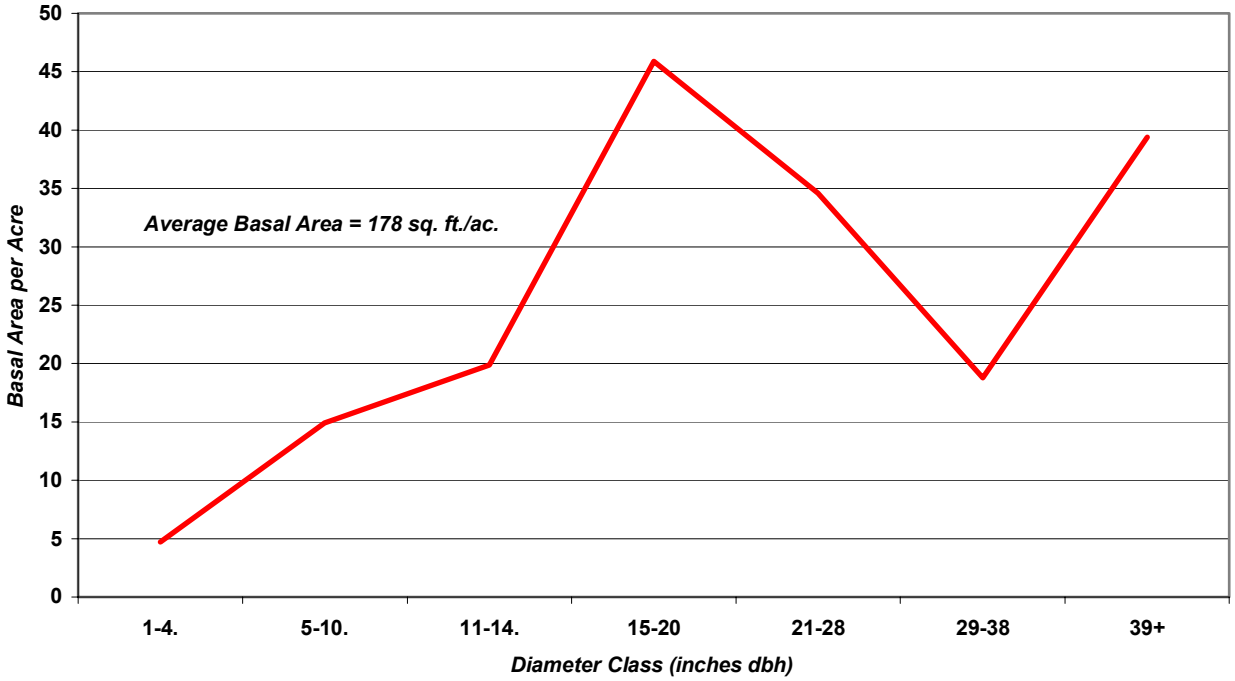
Case Grove Unit



GROVE DENSITY by DIAMETER CLASS

Basal Area per Acre (sq. ft.)

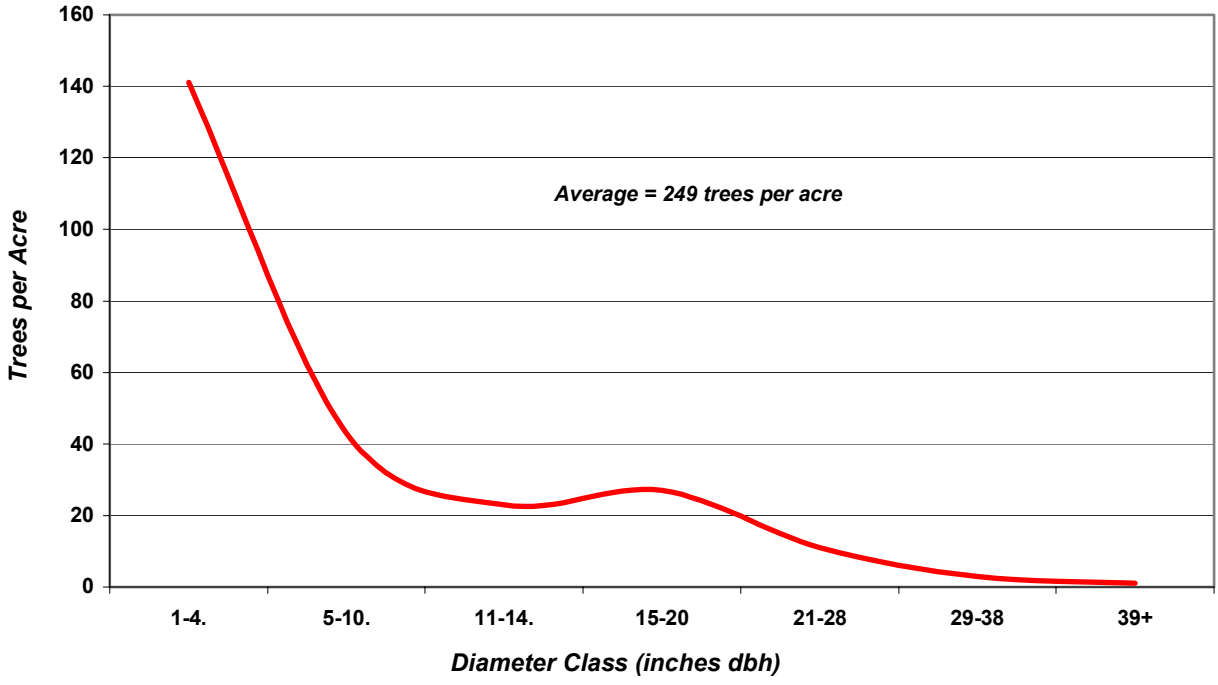
Case Grove Unit



CONIFER STOCKING

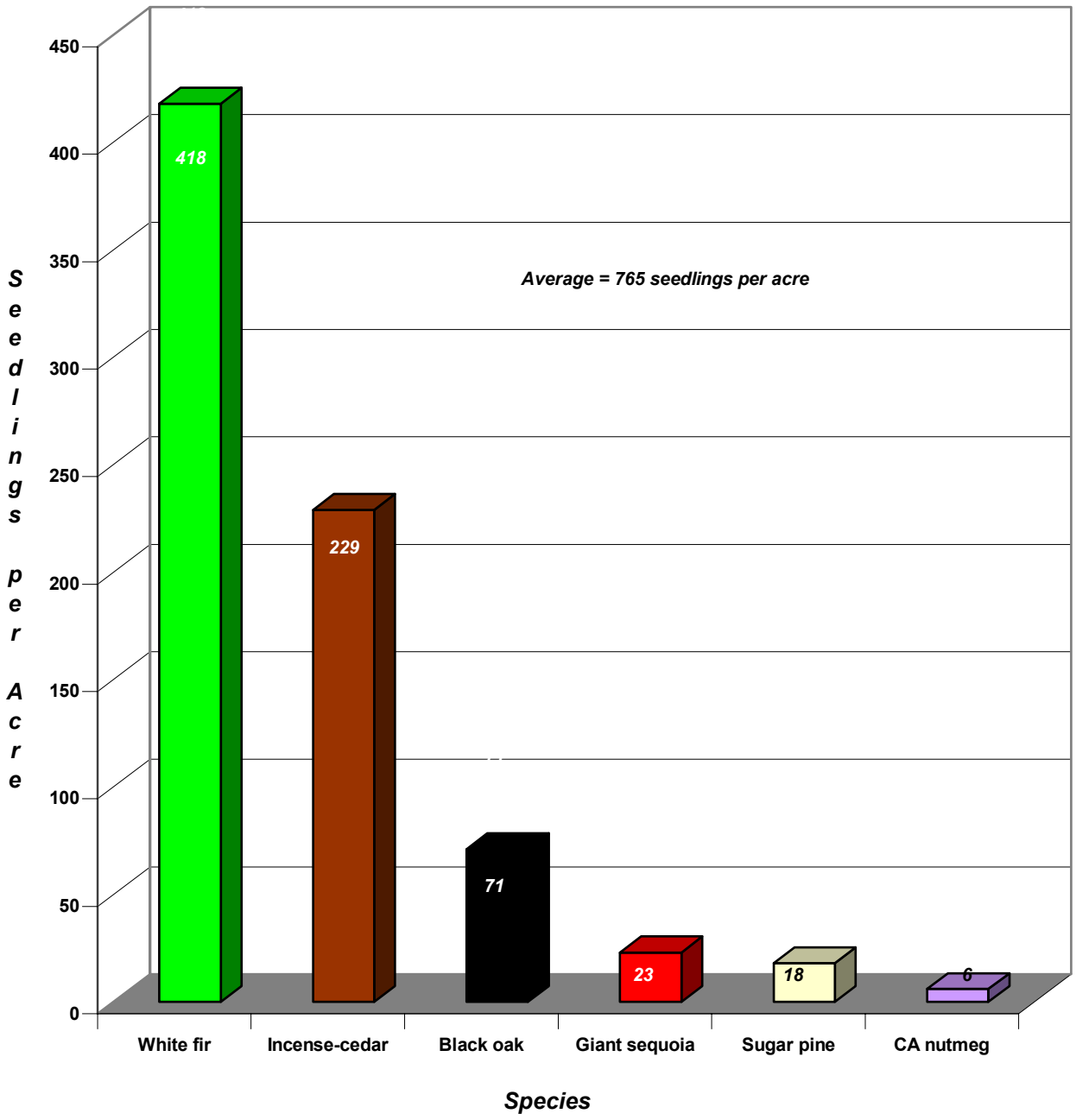
Number of Trees per Acre by Diameter Class

Case Grove Unit



SEEDLINGS per ACRE

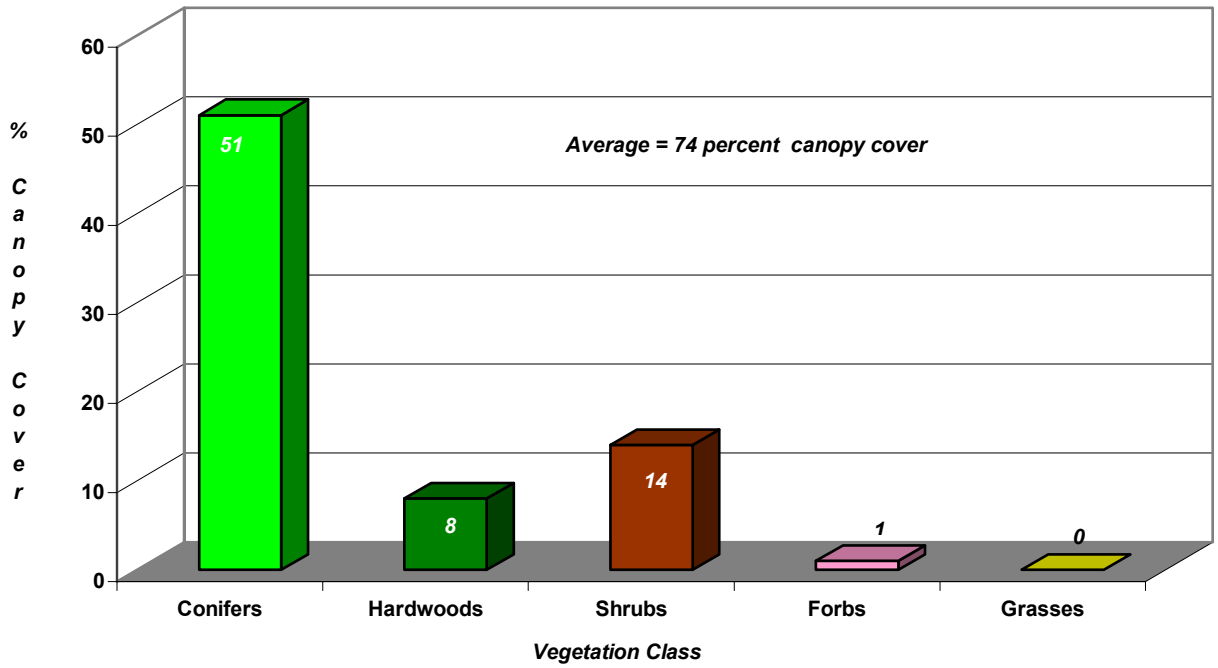
Case Grove Unit



VEGETATION COVER

Percent Canopy Cover by Vegetation Class

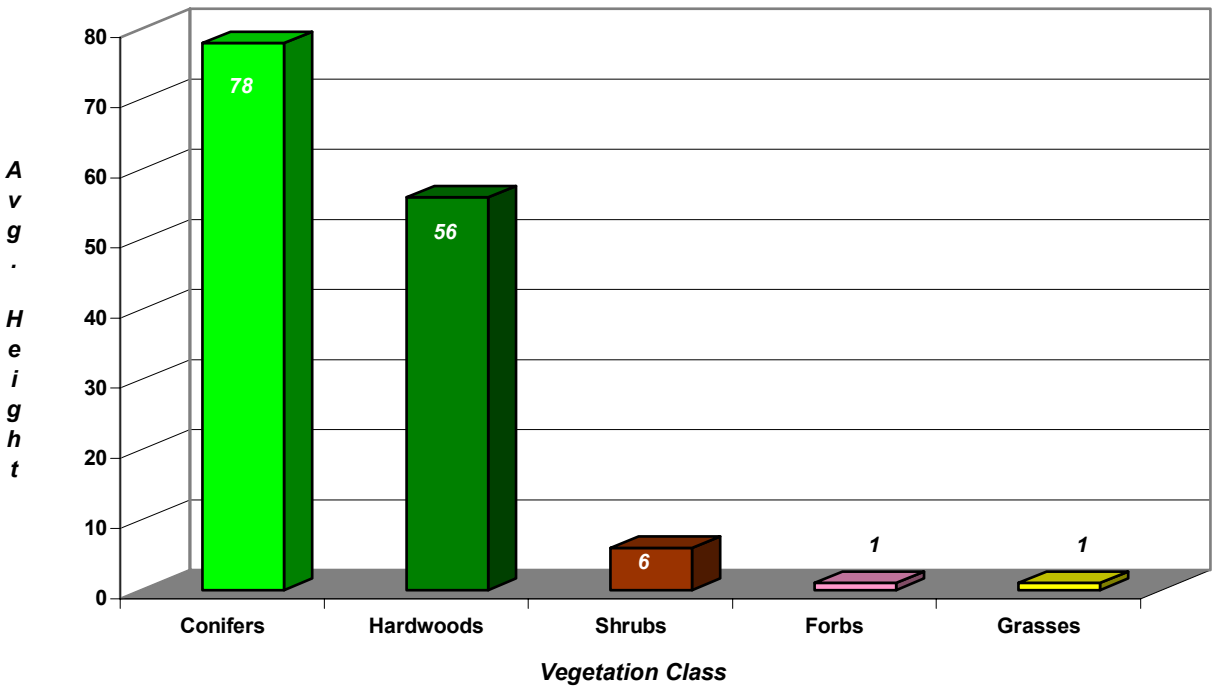
Case Grove Unit



VEGETATION COVER

Average Height (ft.) by Vegetation Class

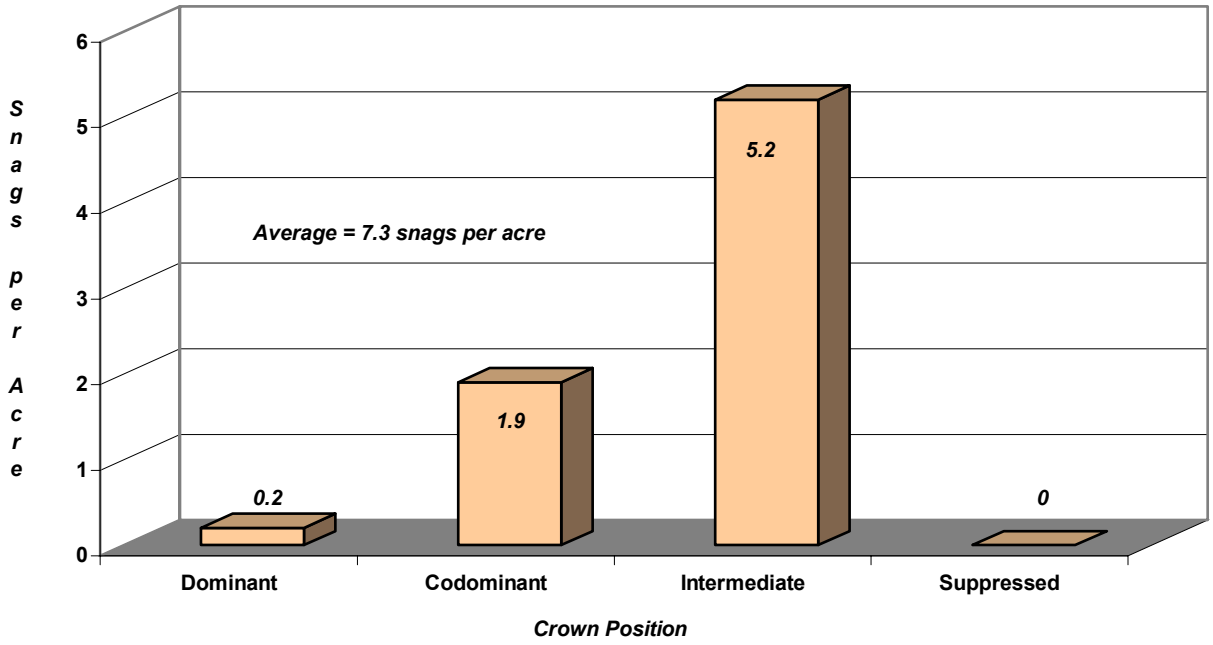
Case Grove Unit



SNAGS

Average Density per Acre by Crown Position

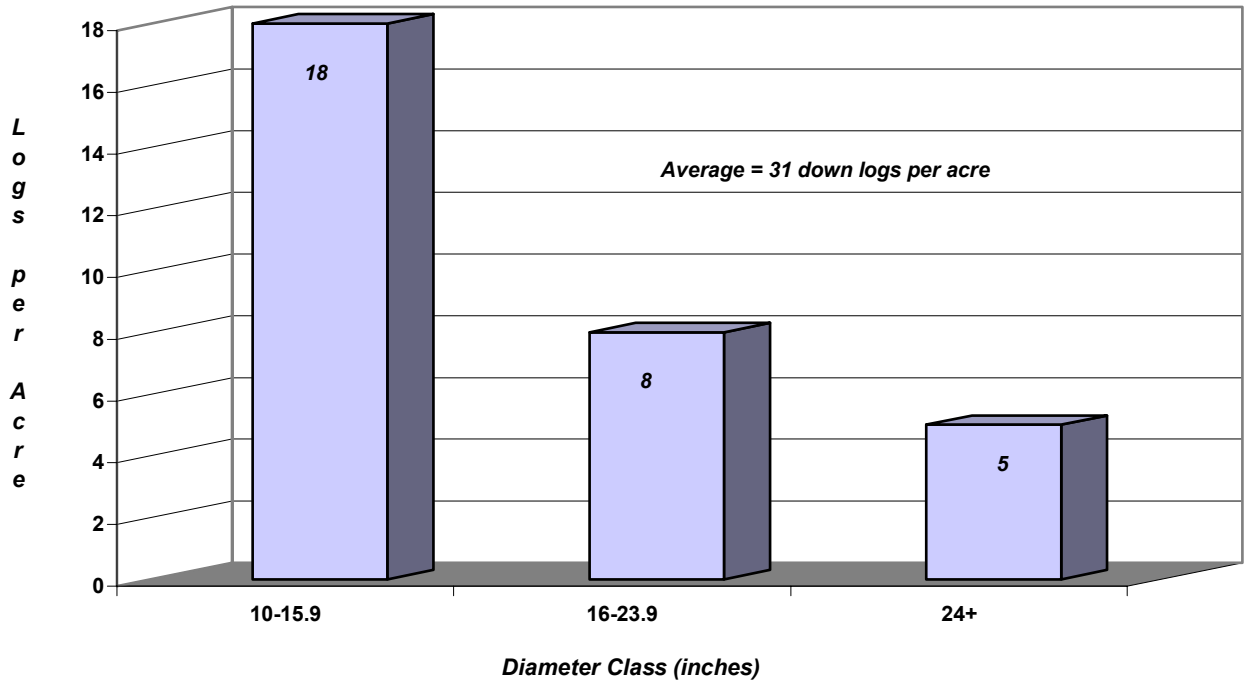
Case Grove Unit



DOWN LOGS

Average Density per Acre by Diameter Class

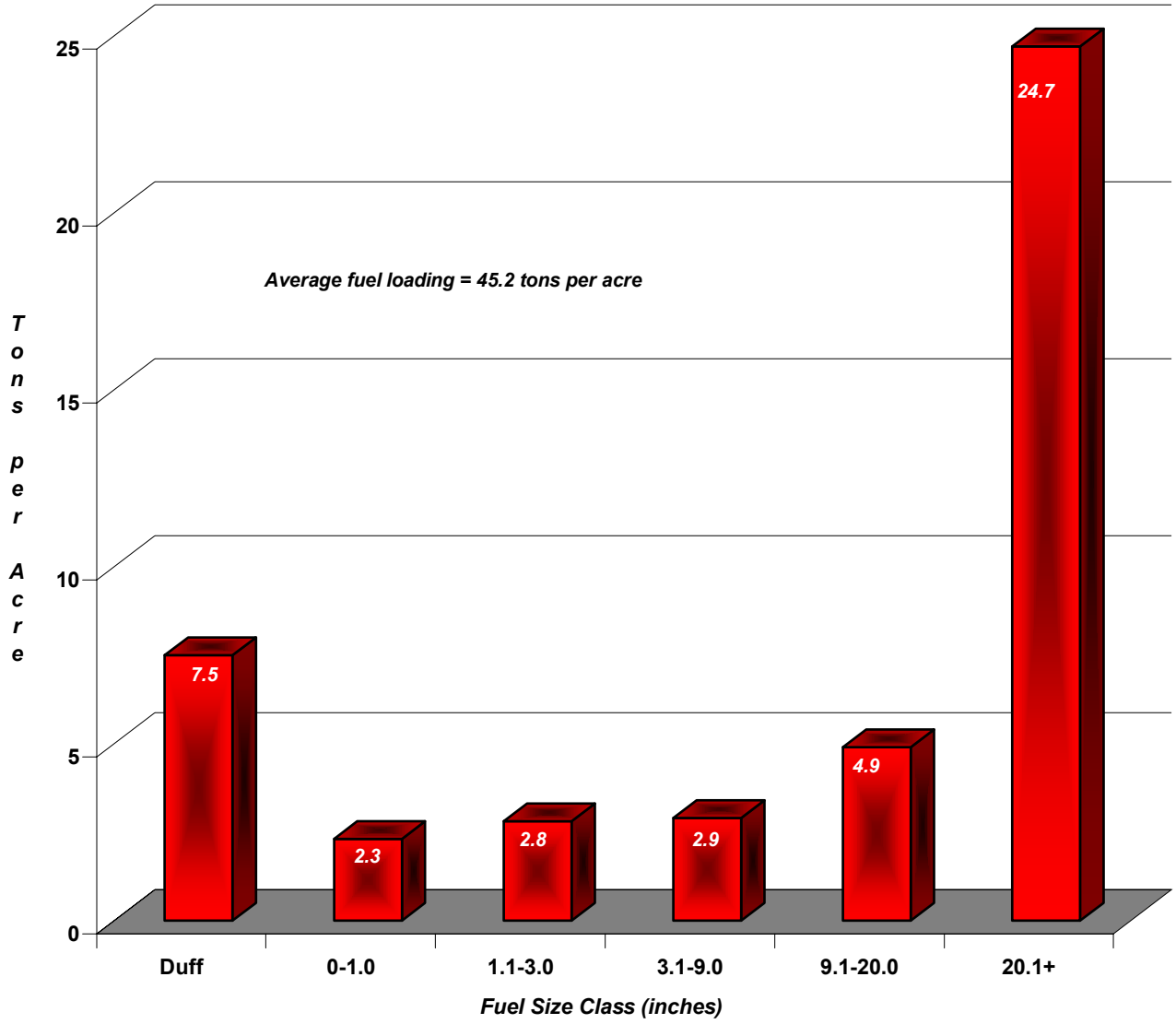
Case Grove Unit



SURFACE FUELS

Fuel Loading, Tons per Acre

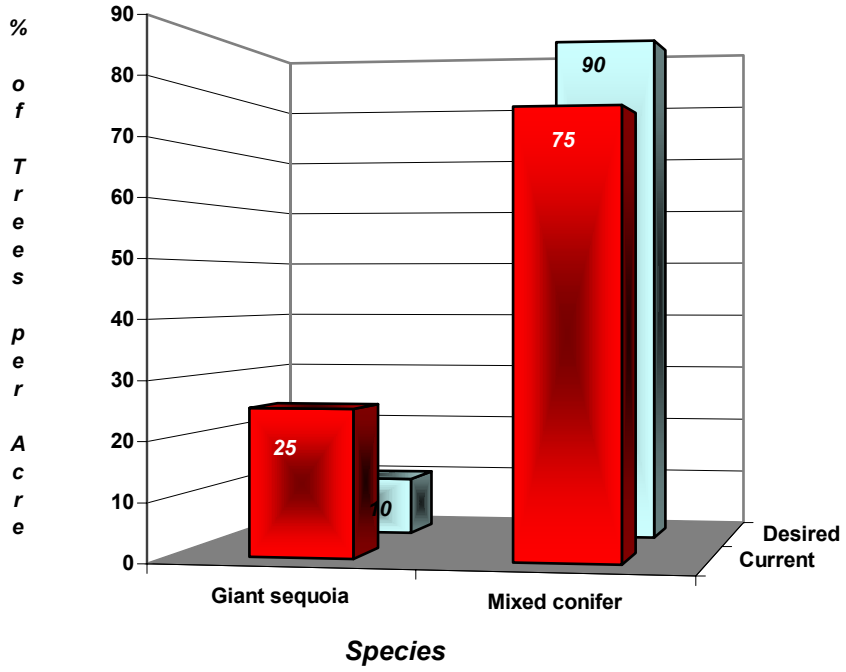
Case Grove Unit



COMPARISON of CURRENT to DESIRED

Percent of Total Number of Trees per Acre

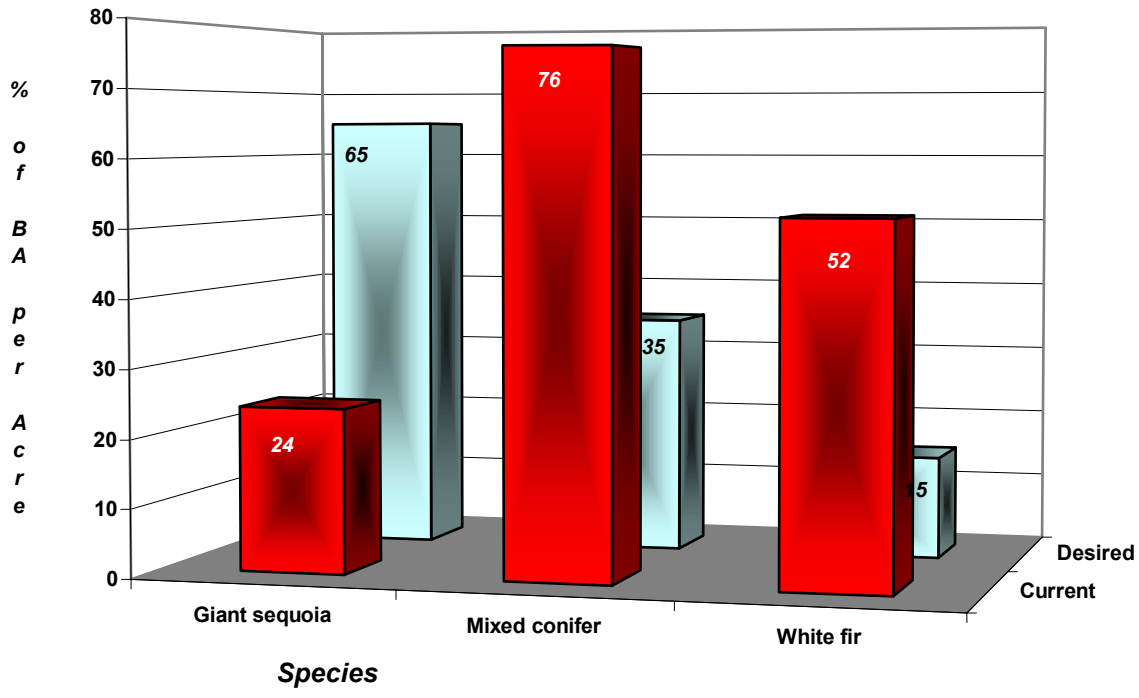
Case Grove Unit



COMPARISON of CURRENT to DESIRED

Percent of Basal Area per Acre (sq. ft.)

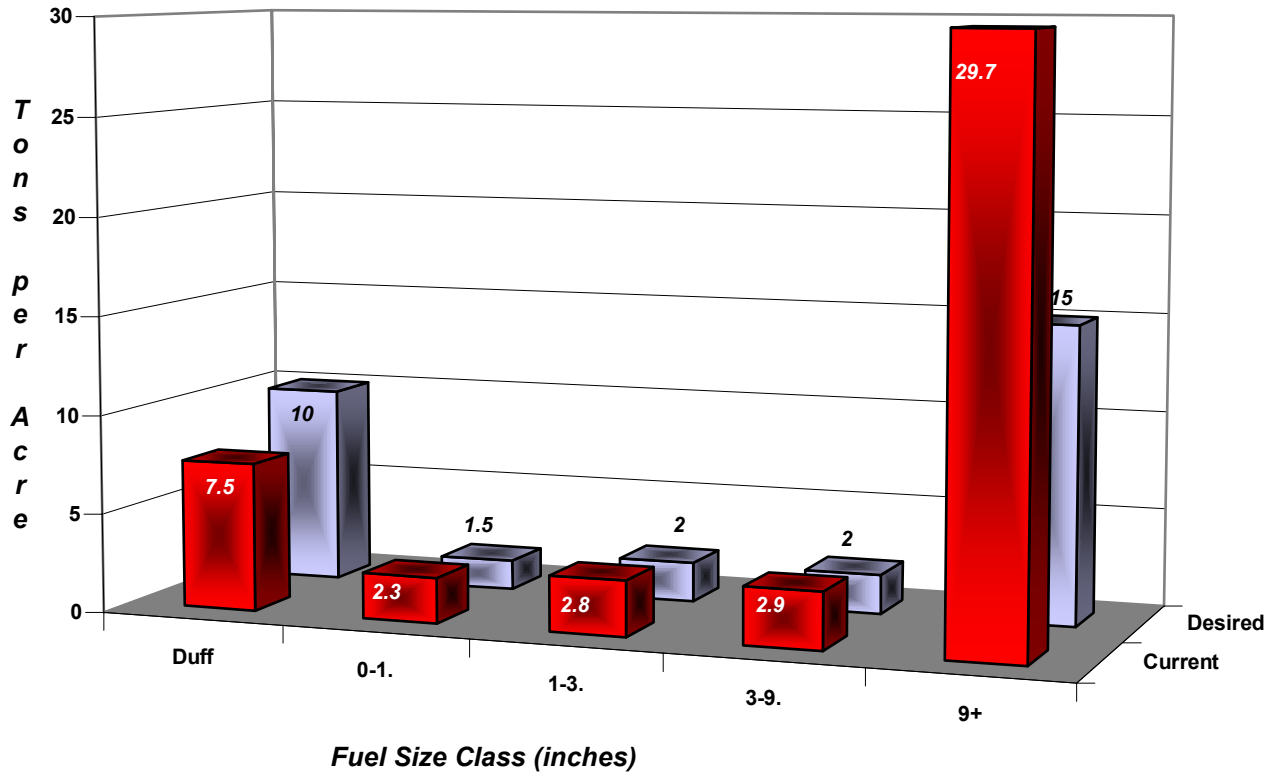
Case Grove Unit



COMPARISON of CURRENT to DESIRED SURFACE FUELS

Fuel Loading, Tons per Acre

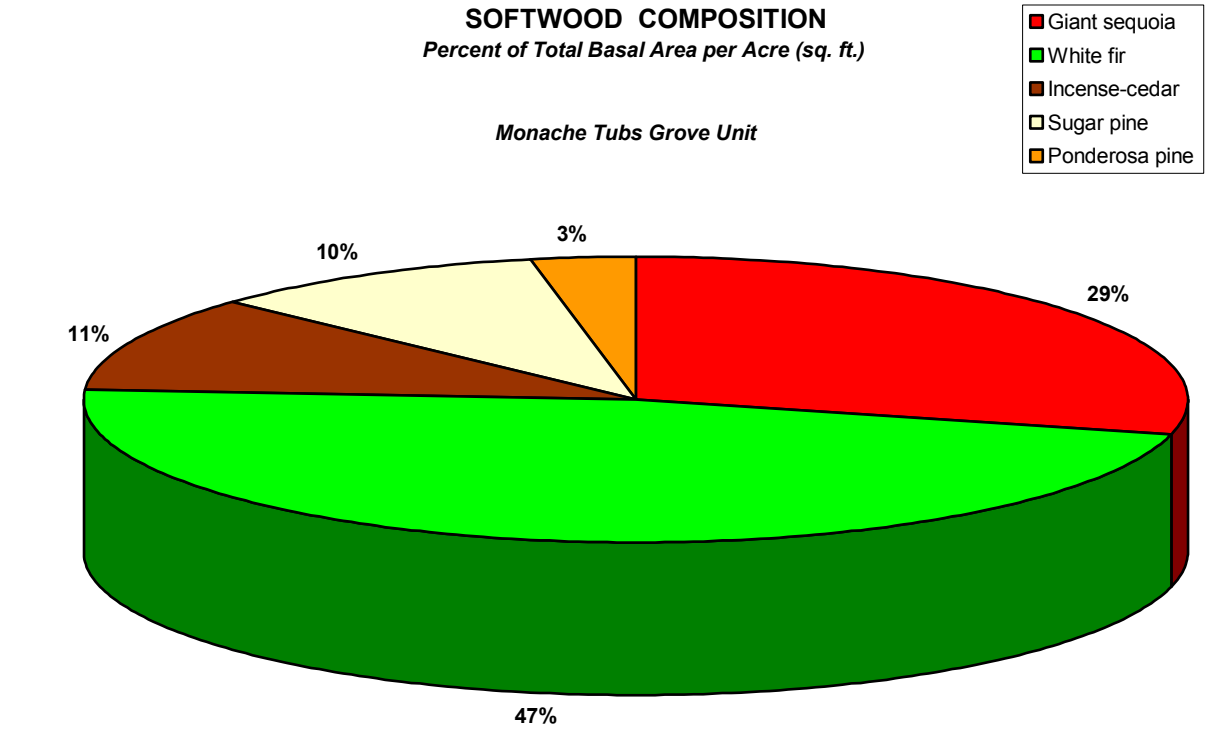
Case Grove Unit

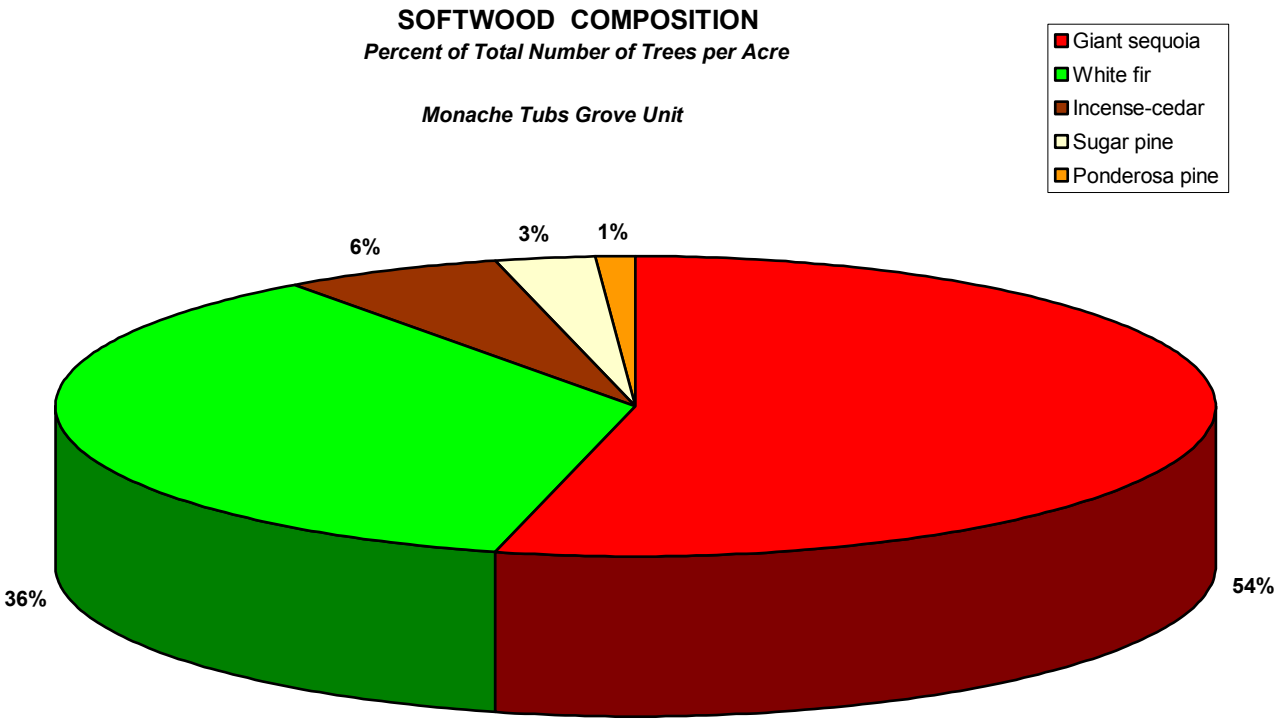


Current fuel loading = 45.2 tons per acre

Desired fuel loading = 18 - 43 tons per acre

Monache Tubs

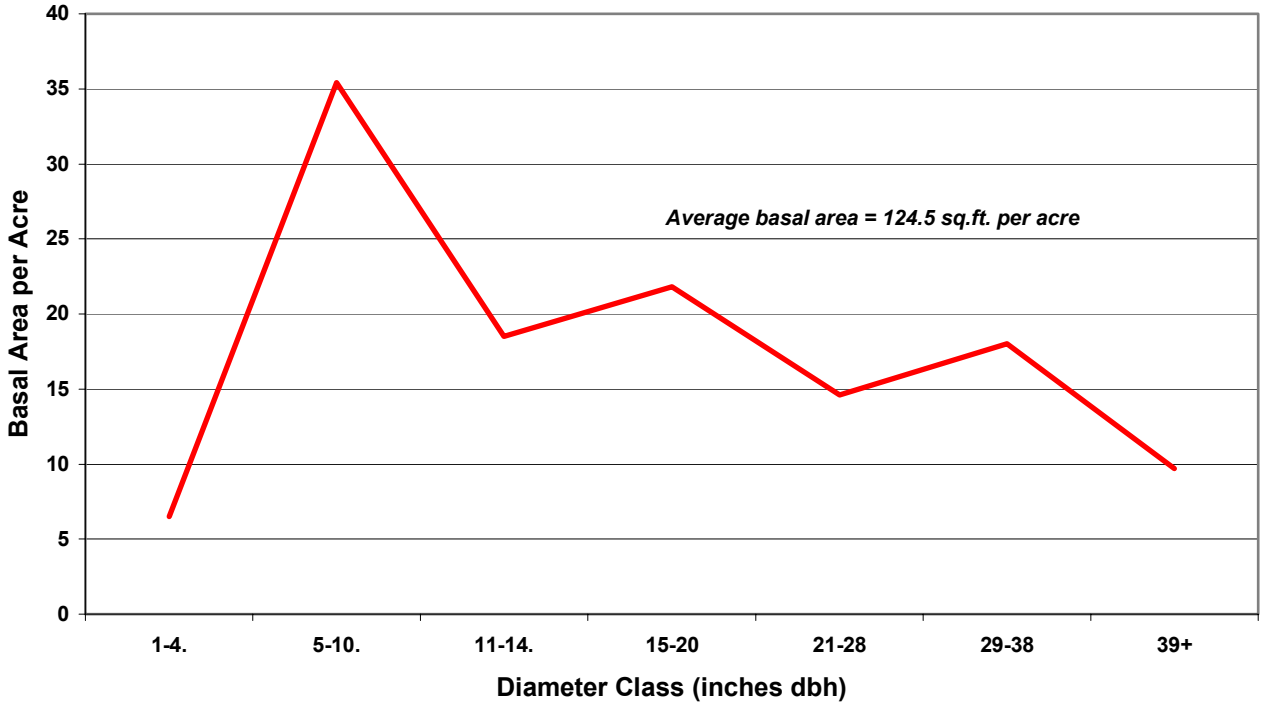

SOFTWOOD COMPOSITION
Percent of Total Basal Area per Acre (sq. ft.)
Monache Tubs Grove Unit
Giant sequoia
White fir
Incense-cedar
Sugar pine
Ponderosa pine
3%
10%
29%
11%
47%


SOFTWOOD COMPOSITION
Percent of Total Number of Trees per Acre
Monache Tubs Grove Unit
Giant sequoia
White fir
Incense-cedar
Sugar pine
Ponderosa pine
6%
3%
1%
36%
54%

GROVE DENSITY by DIAMETER CLASS (conifers)

Basal Area per Acre (sq. ft.)

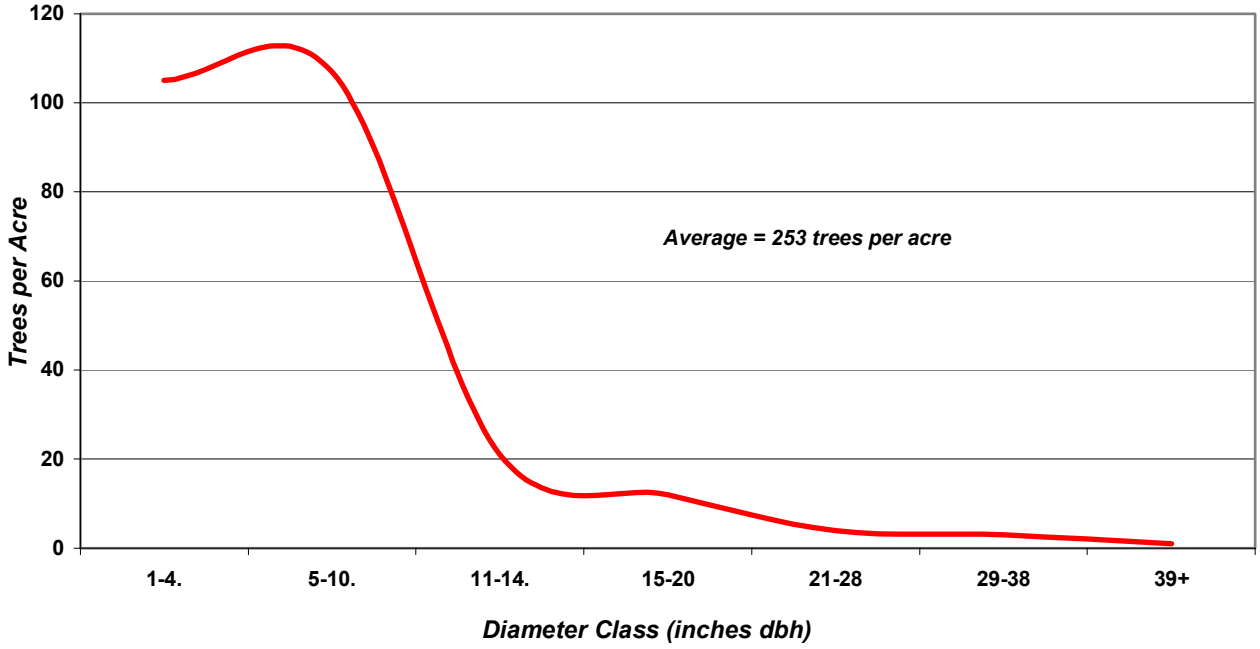
Monache Tubs Grove Unit



CONIFER STOCKING

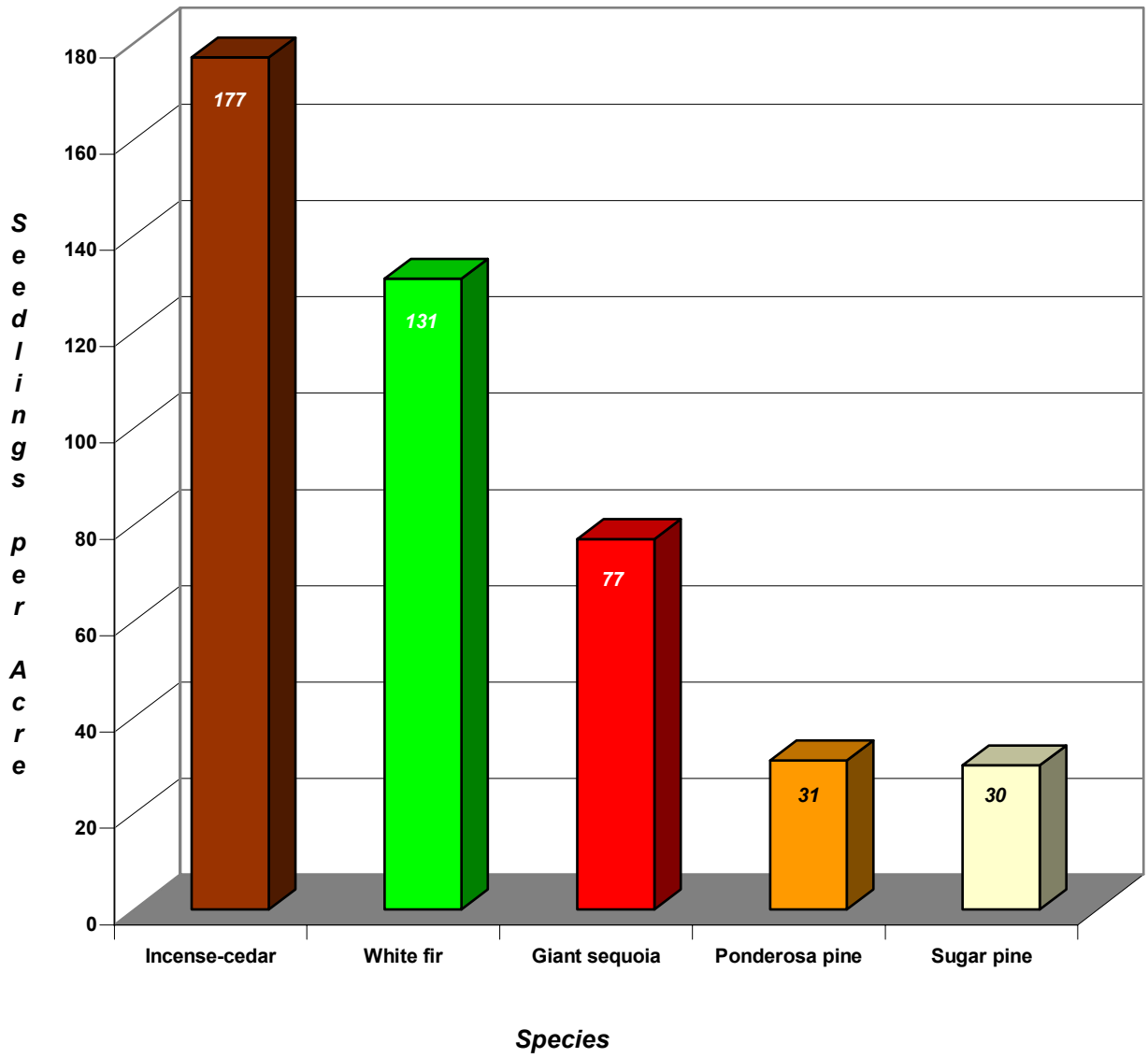
Number of Trees per Acre by Diameter Class

Monache Tubs Grove Unit



SEEDLINGS per ACRE

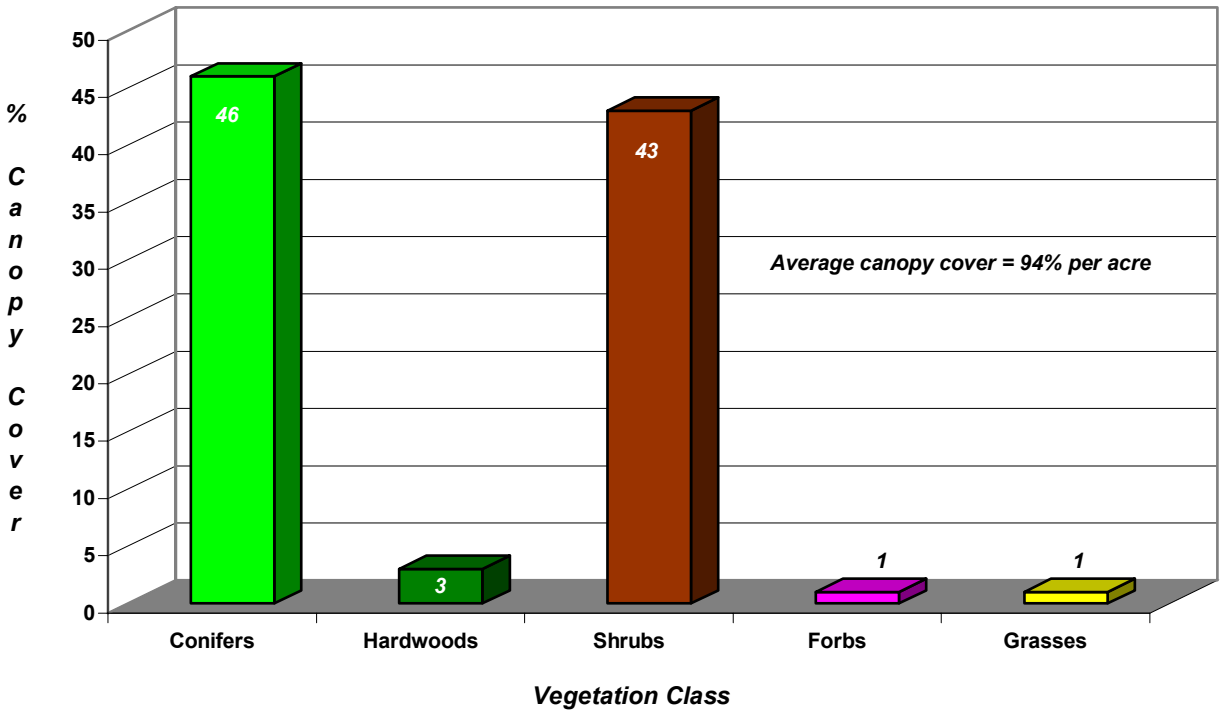
Monache Tubs Grove Unit



VEGETATION COVER

% Canopy Cover by Vegetation Class

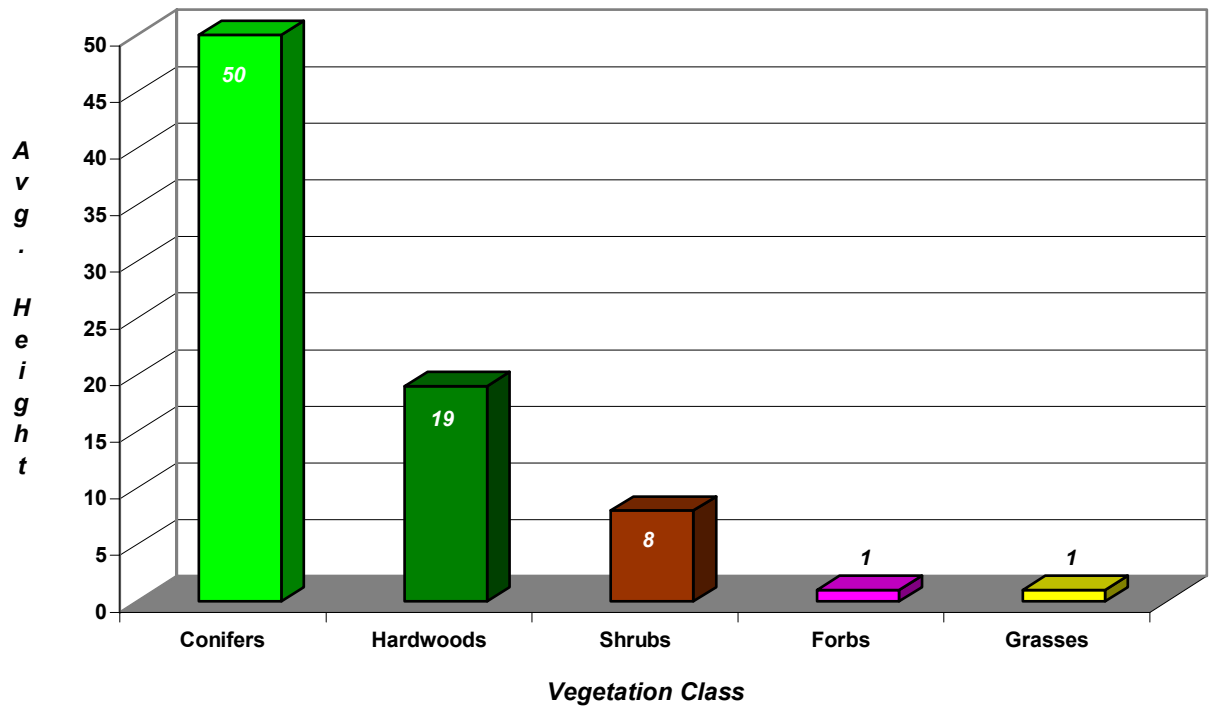
Monache Tubs Grove Unit



VEGETATION COVER

Average Height (ft.)

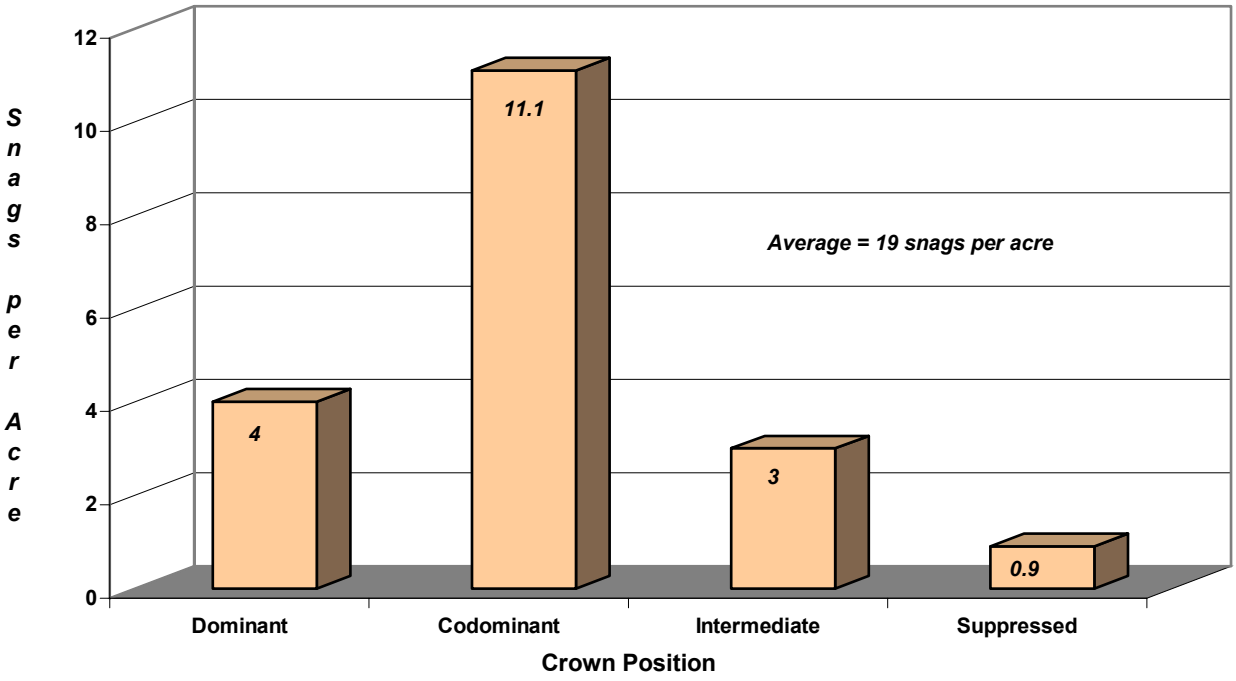
Monache Tubs Grove Unit



SNAGS

Average Density per Acre by Crown Position

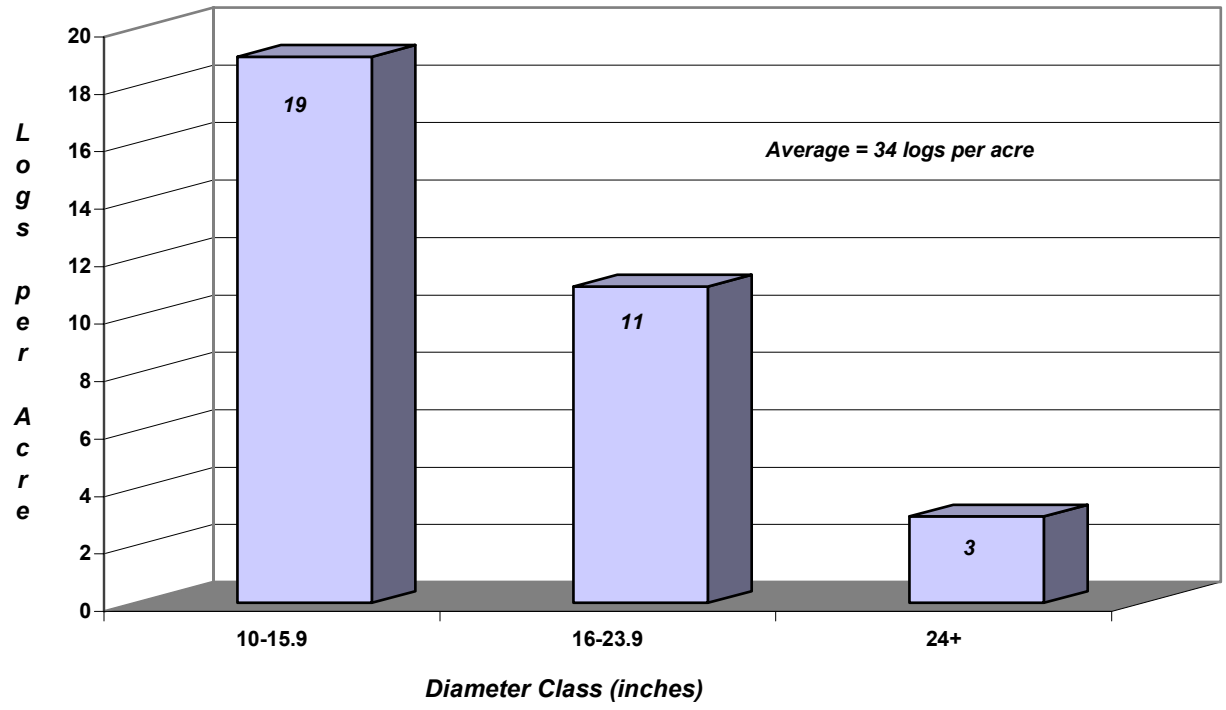
Monache Tubs Grove Unit



DOWN LOGS

Average Density per Acre by Diameter Class

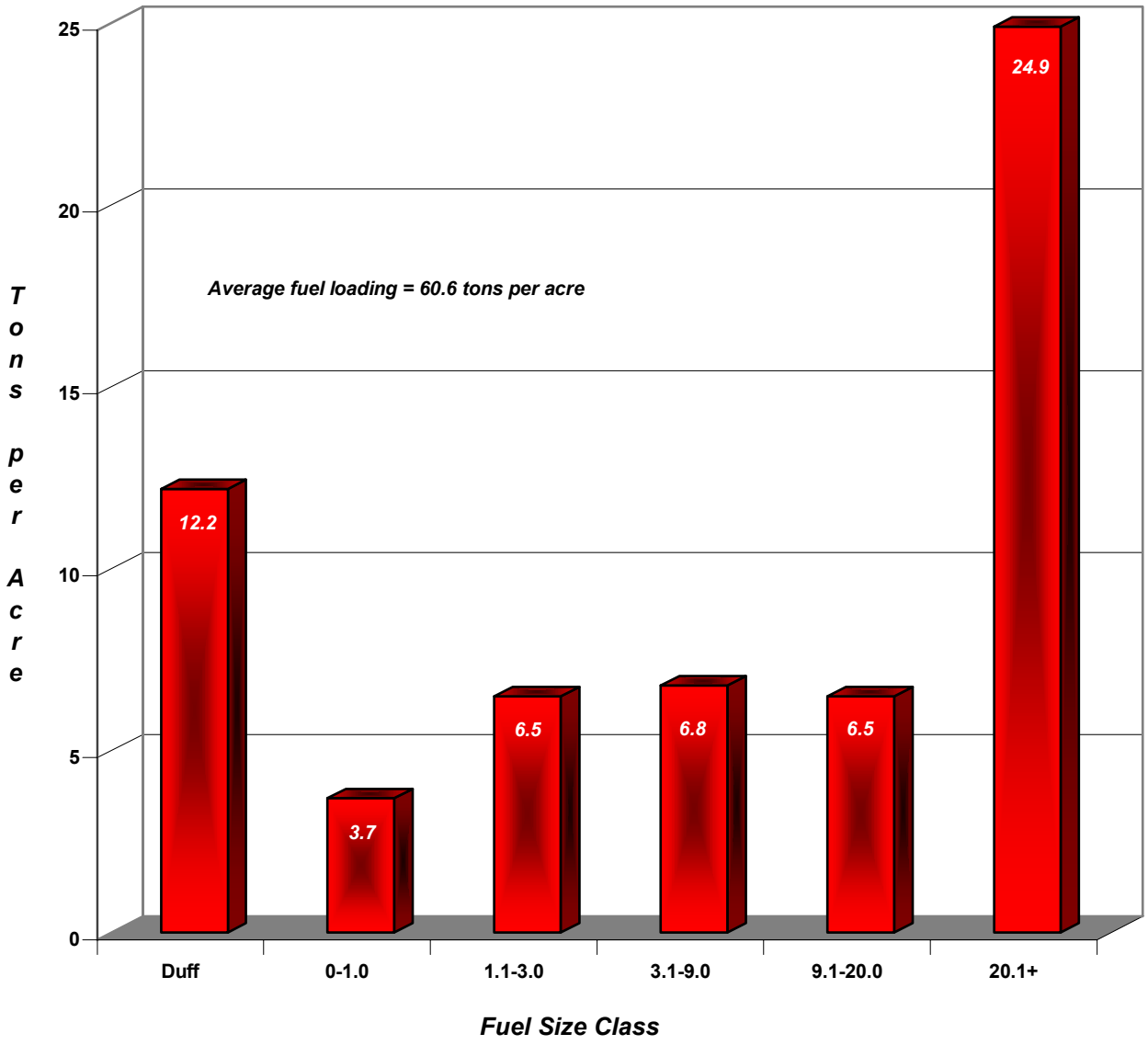
Monache Tubs Grove Unit



SURFACE FUELS

Fuel Loading, Tons per Acre

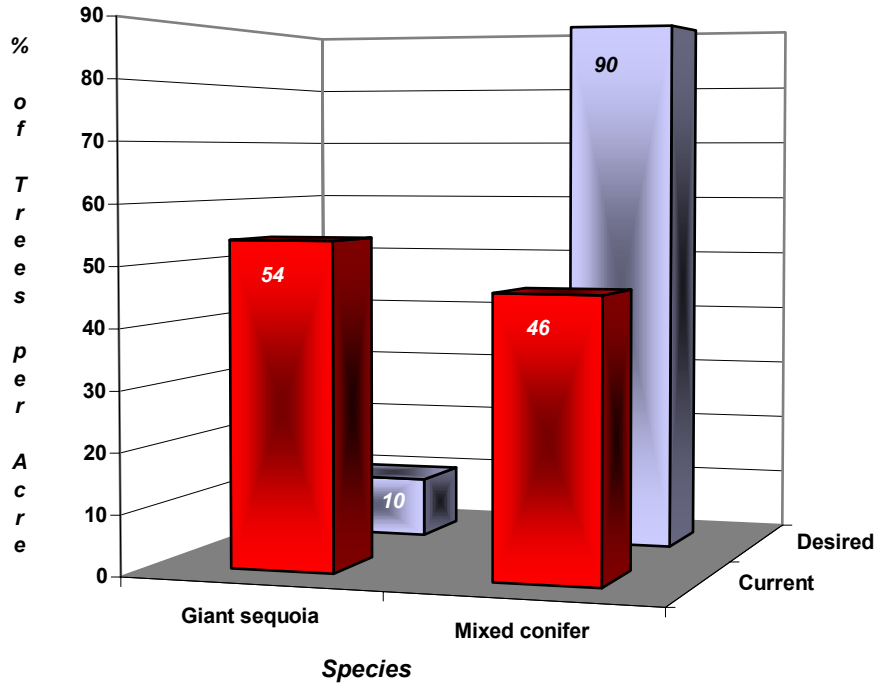
Monache Tubs Grove Unit



COMPARISON of CURRENT to DESIRED

Percent of Total Number of Trees per Acre

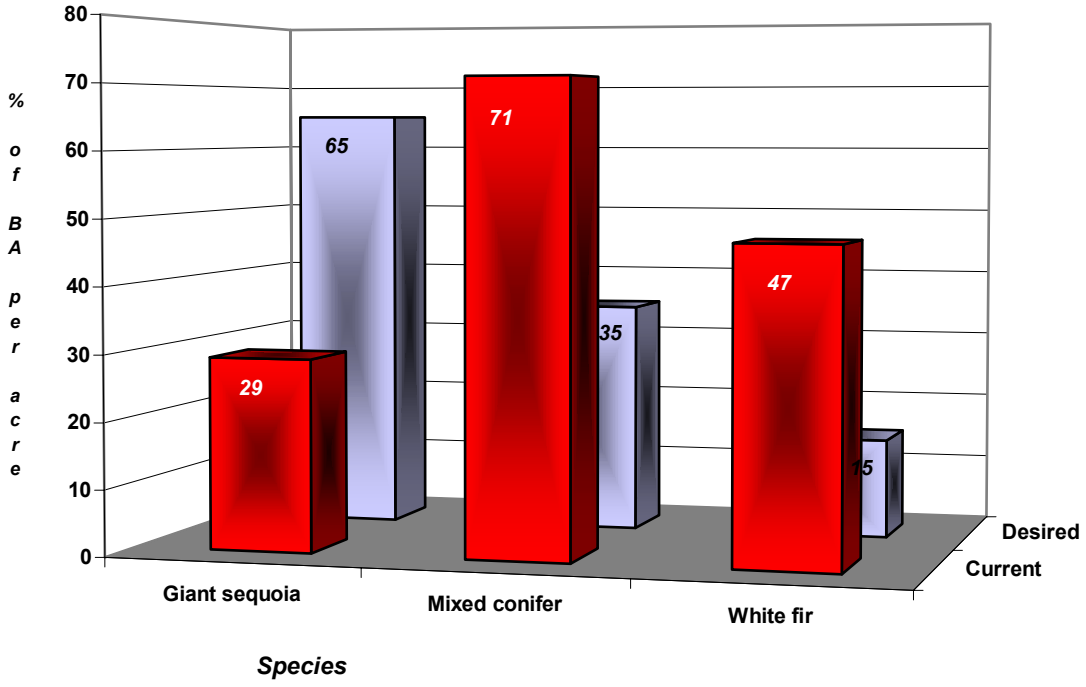
Monache Tubs Grove Unit



COMPARISON of CURRENT to DESIRED

Percent of Average Basal Area per Acre (sq. ft.)

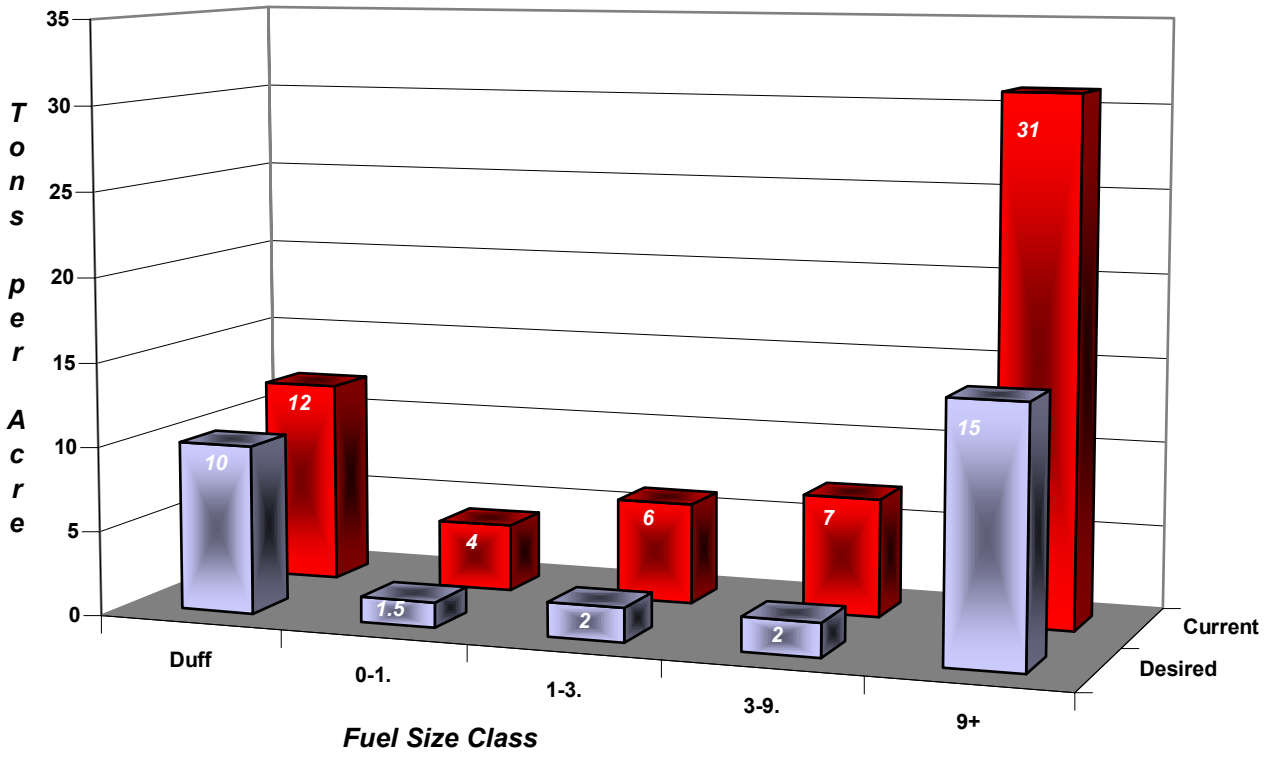
Monache Tubs Grove Unit



COMPARISON of CURRENT to DESIRED SURFACE FUELS

Fuel Loading, Tons per Acre

Monache Tubs Grove Unit



Current = 60.6 tons per acre

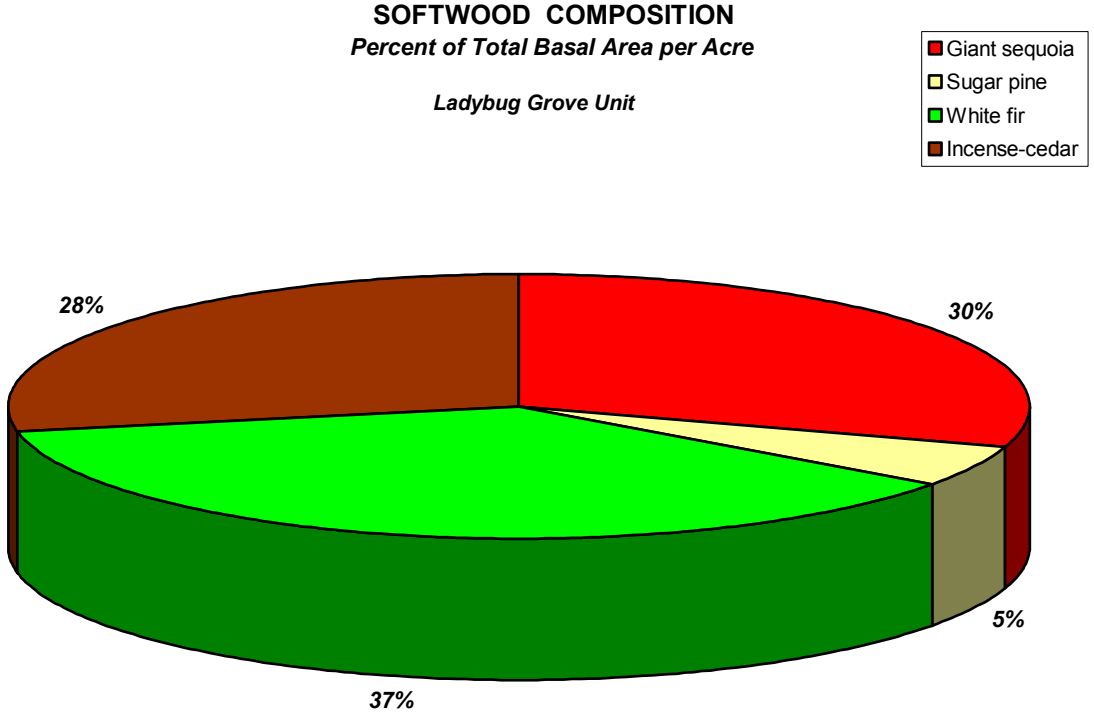
Desired = 18 - 43 tons per acre

Ladybug

SOFTWOOD COMPOSITION

Percent of Total Basal Area per Acre

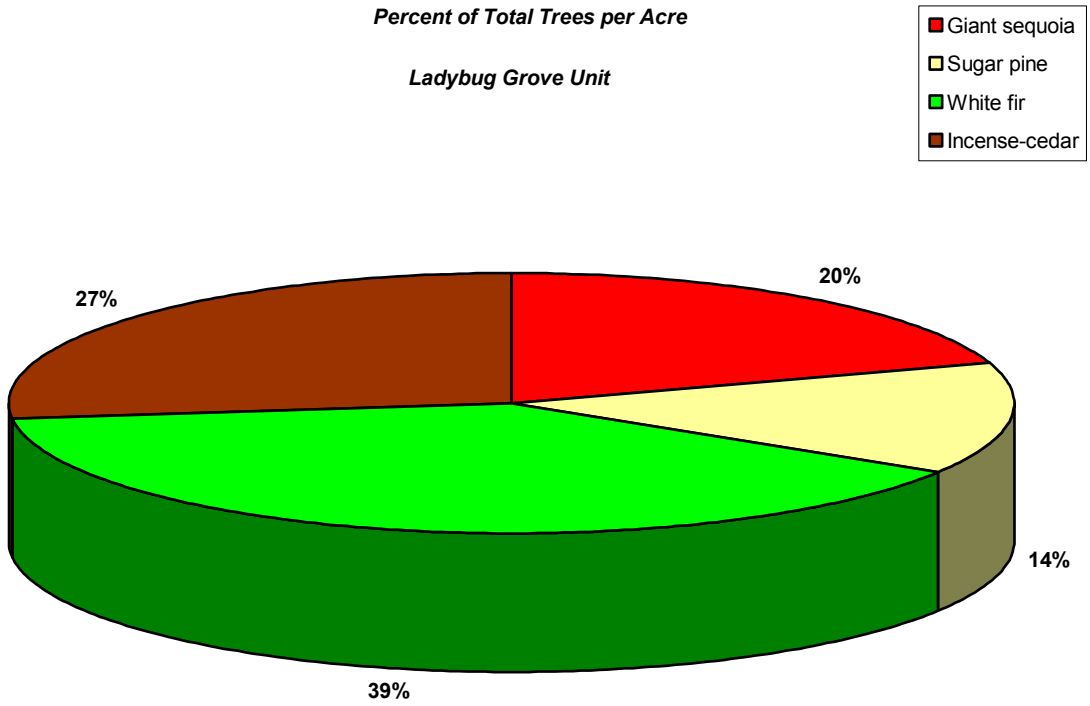
Ladybug Grove Unit



SOFTWOOD COMPOSITION

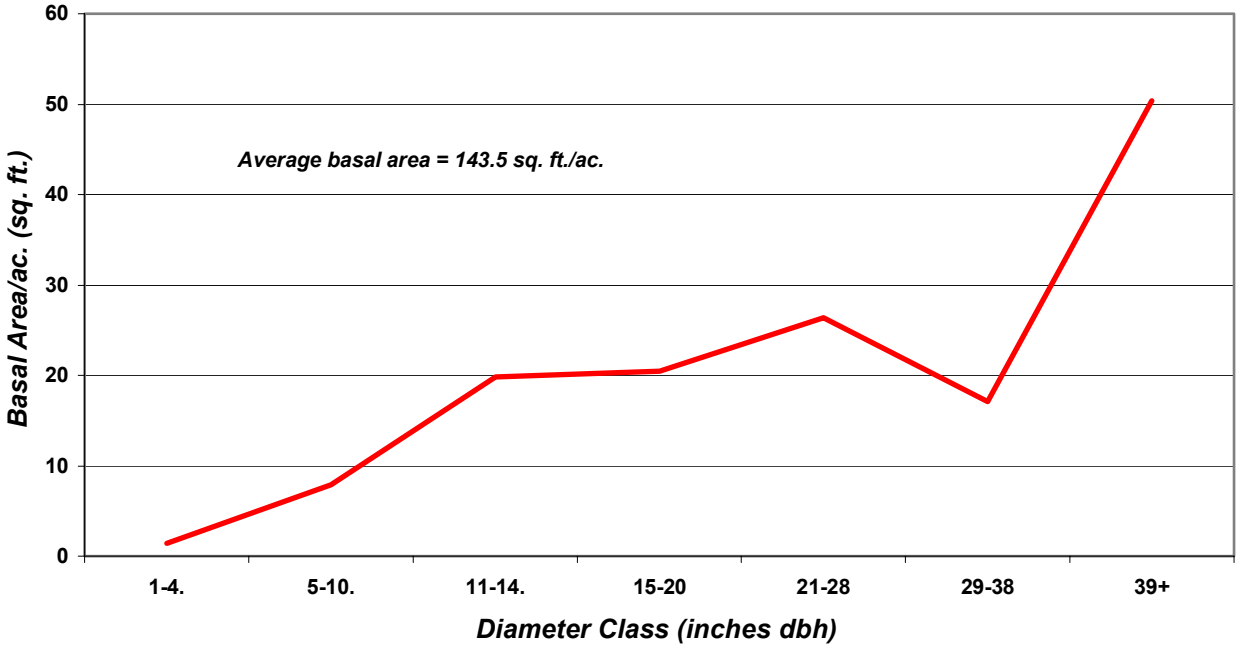
Percent of Total Trees per Acre

Ladybug Grove Unit



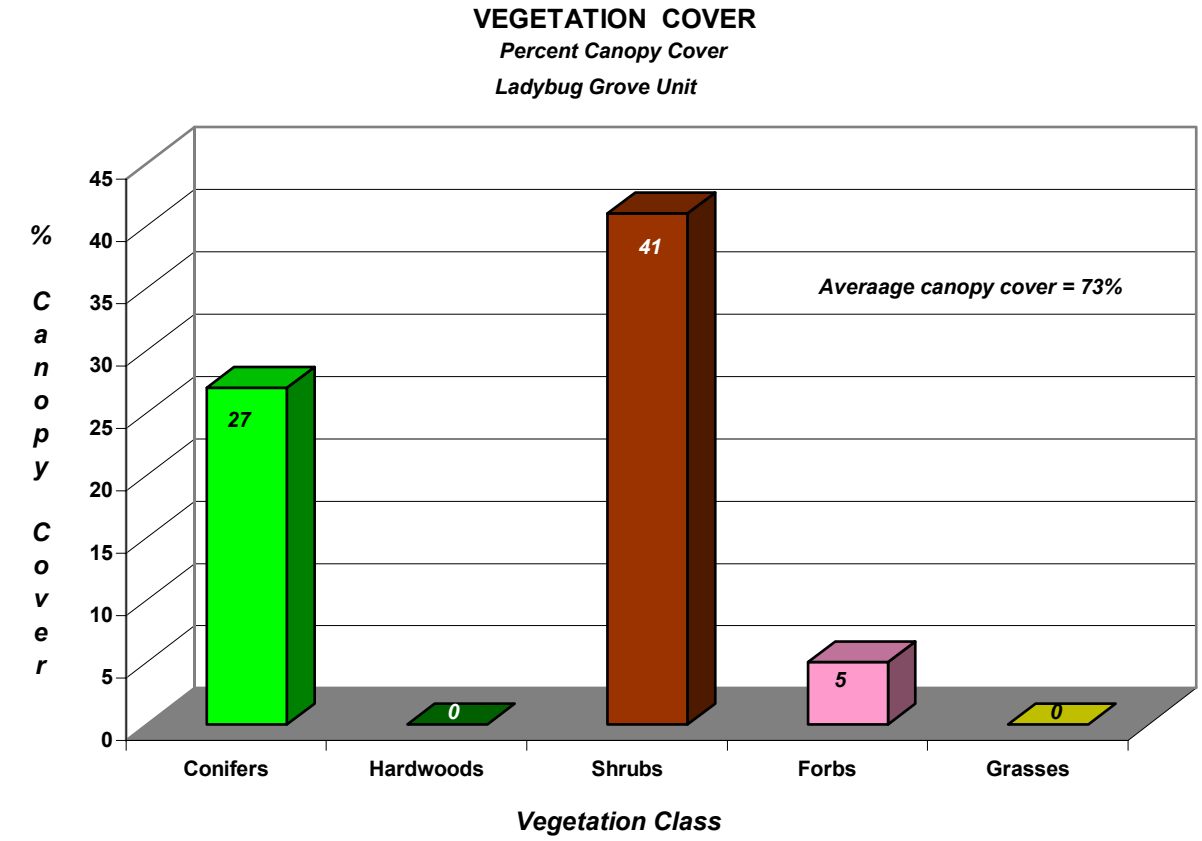
GROVE DENSITY by TREE DIAMETER CLASS (conifers)
Basal Area per Acre

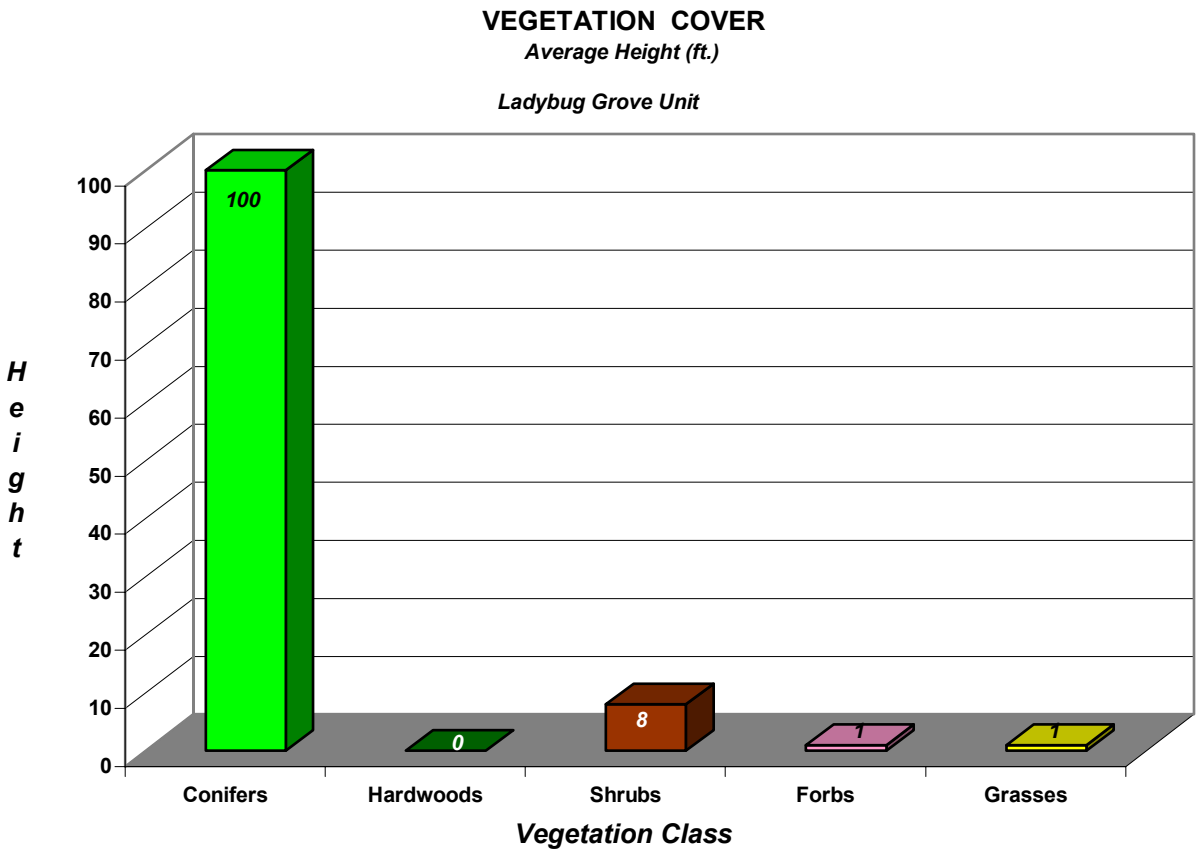
Ladybug Grove Unit



TREE STOCKING by DIAMETER CLASS (conifers)
Number of Trees per Acre

Ladybug Grove Unit

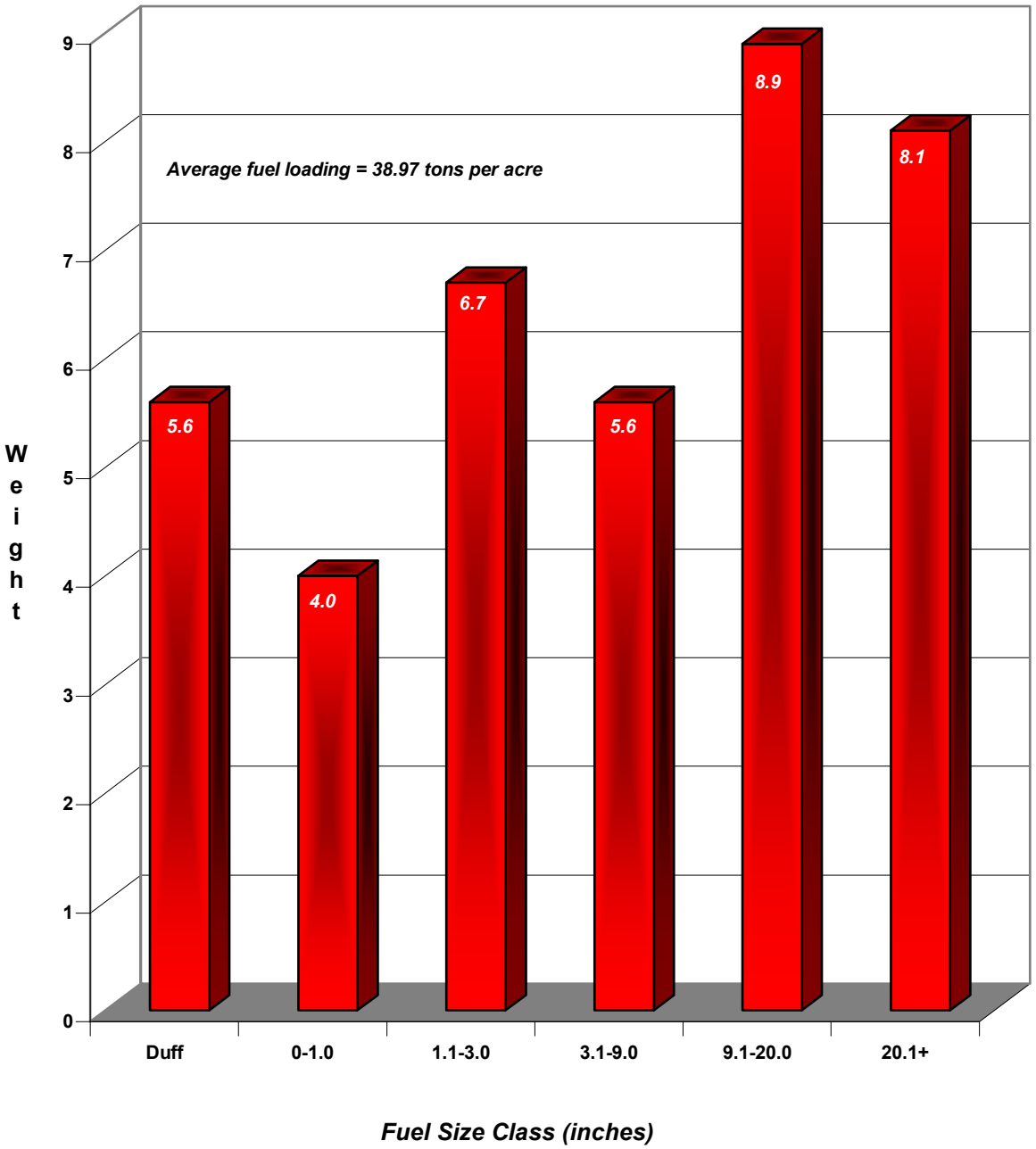

VEGETATION COVER
Percent Canopy Cover
Ladybug Grove Unit
% Canopy Cover
45
40
35
30
25
20
15
10
5
0
27
0
41
5
0
Averaage canopy cover = 73%
Conifers
Hardwoods
Shrubs
Forbs
Grasses
Vegetation Class


VEGETATION COVER
Average Height (ft.)
Ladybug Grove Unit
Height
100
90
80
70
60
50
40
30
20
10
0
100
0
8
1
1
Conifers
Hardwoods
Shrubs
Forbs
Grasses
Vegetation Class

SURFACE FUELS

Fuel Loading, Tons per Acre

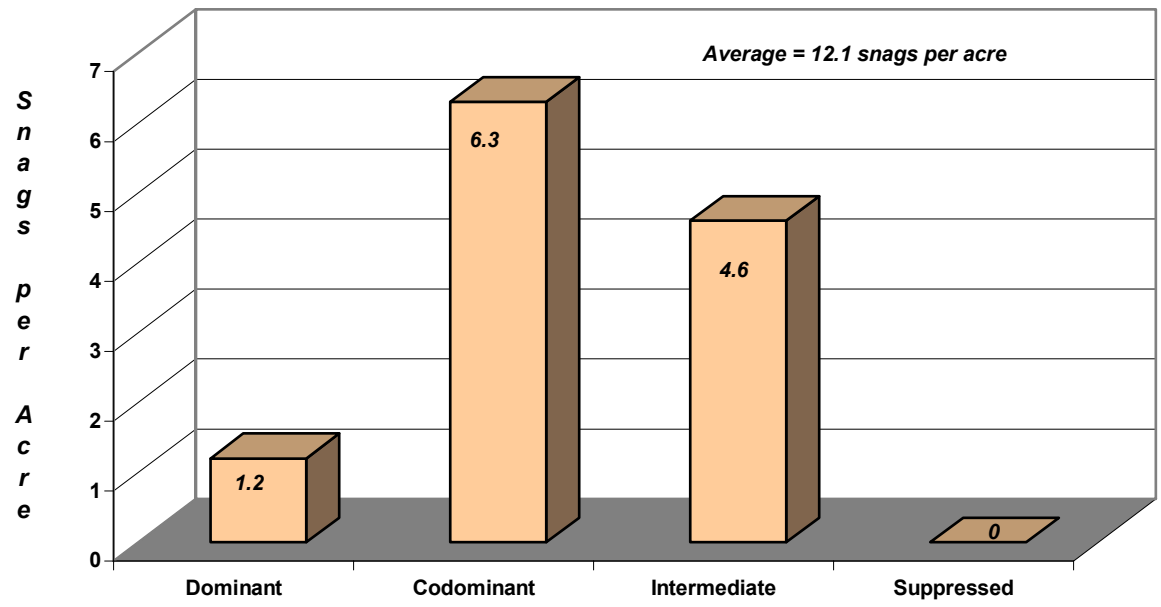
Ladybug Grove Unit



SNAGS (all species)

Average Density per Acre by Canopy Position

Ladybug Grove Unit

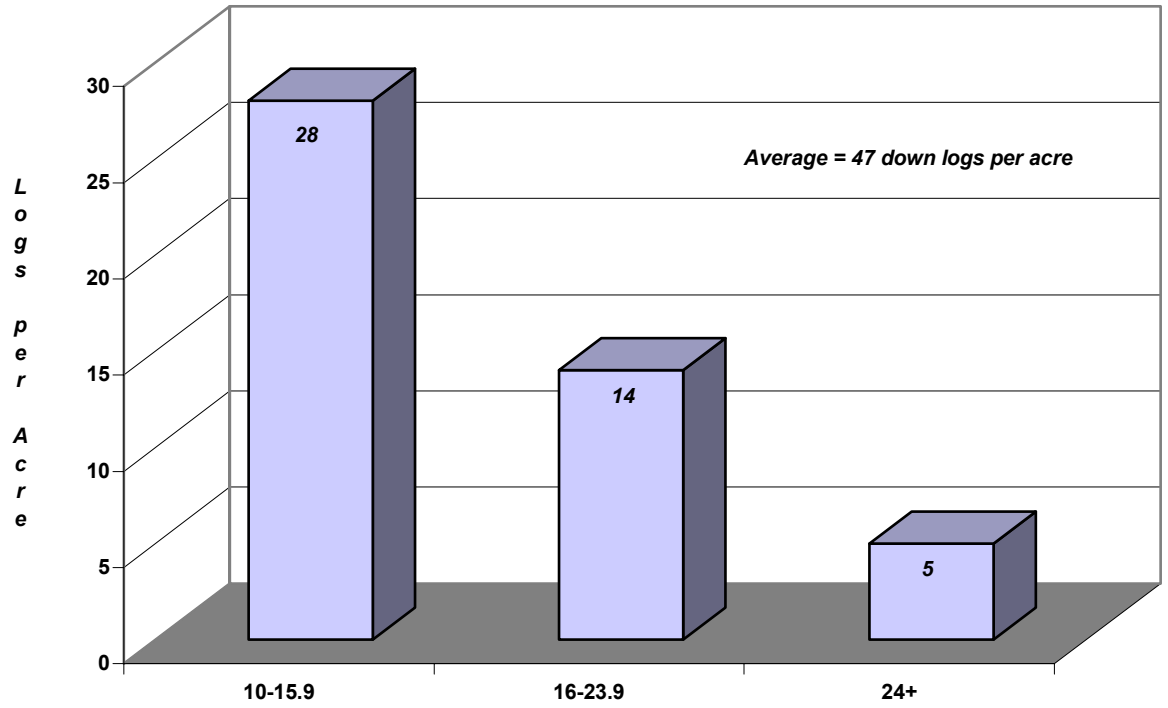


Canopy Position

DOWN LOGS (all species)

Average Density per Acre

Ladybug Grove Unit

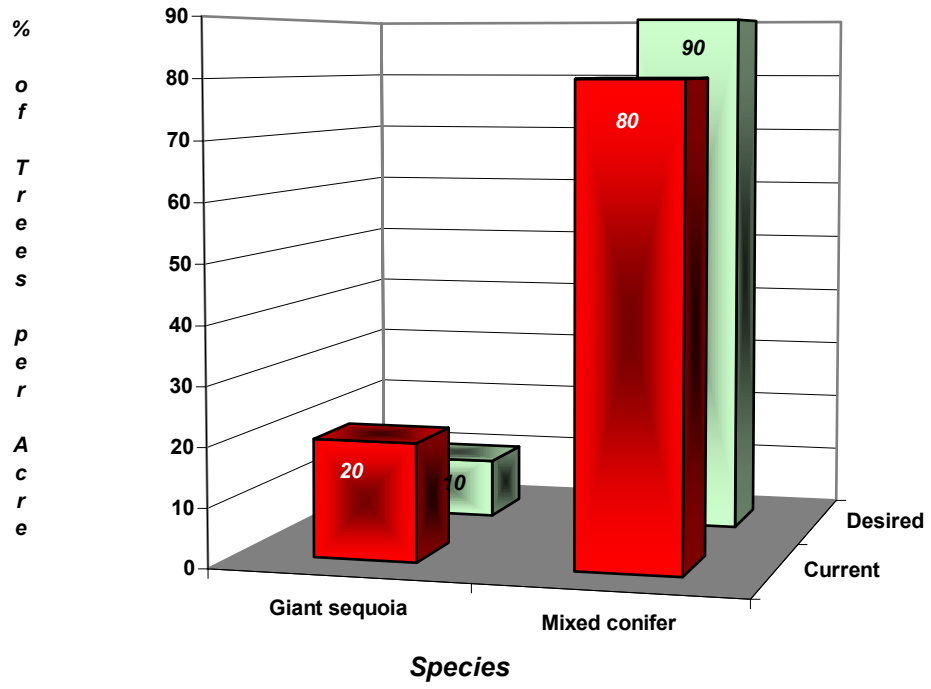


Diameter Class (inches)

COMPARISON of CURRENT to DESIRED

Percent of Total Trees per Acre

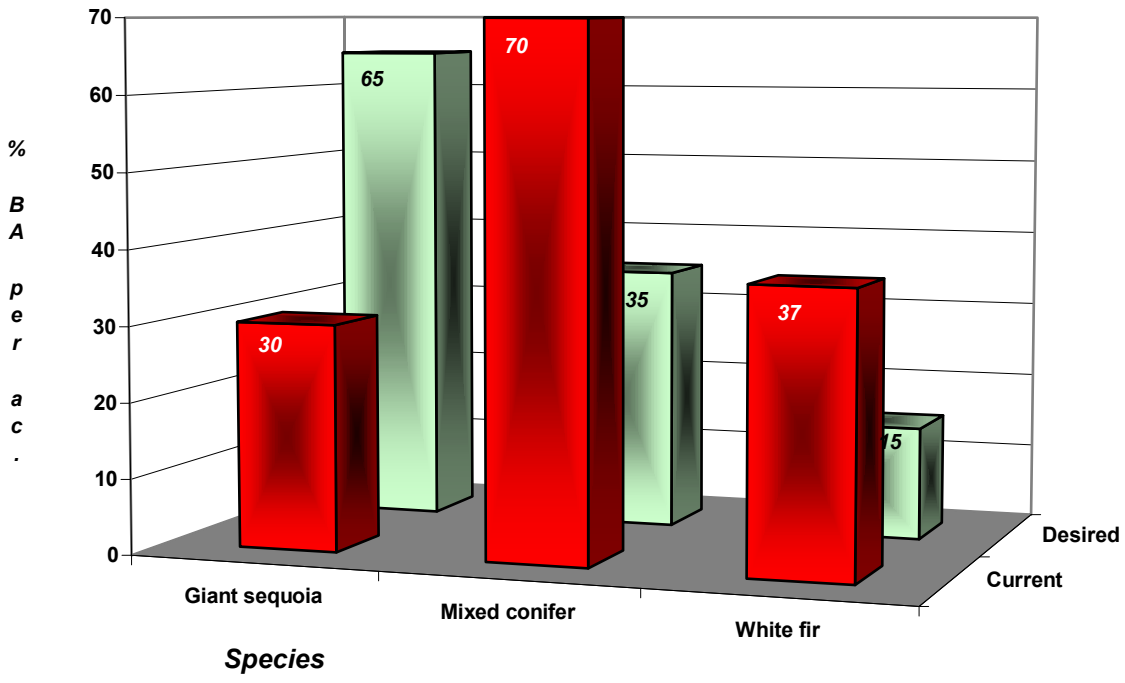
Ladybug Grove Unit



COMPARISON of CURRENT to DESIRED

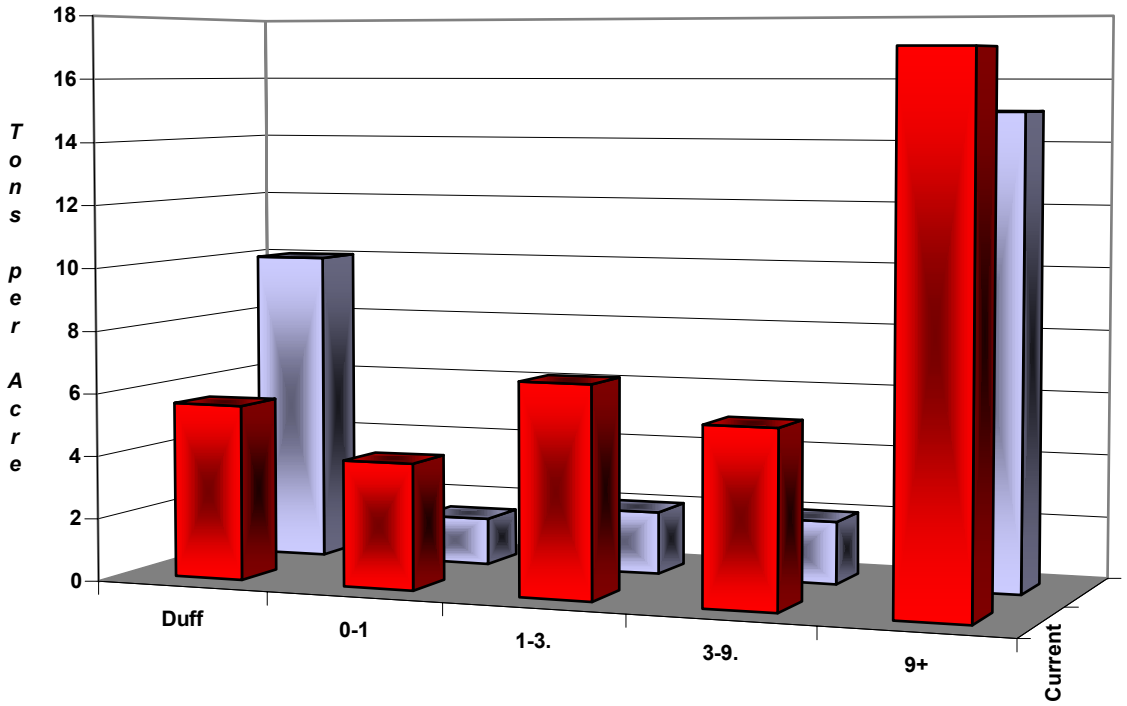
Percent of Total Basal Area per Acre (sq. ft.)

Ladybug Grove Unit



COMPARISON of CURRENT to DESIRED SURFACE FUELS
Fuel Loading, Tons per Acre

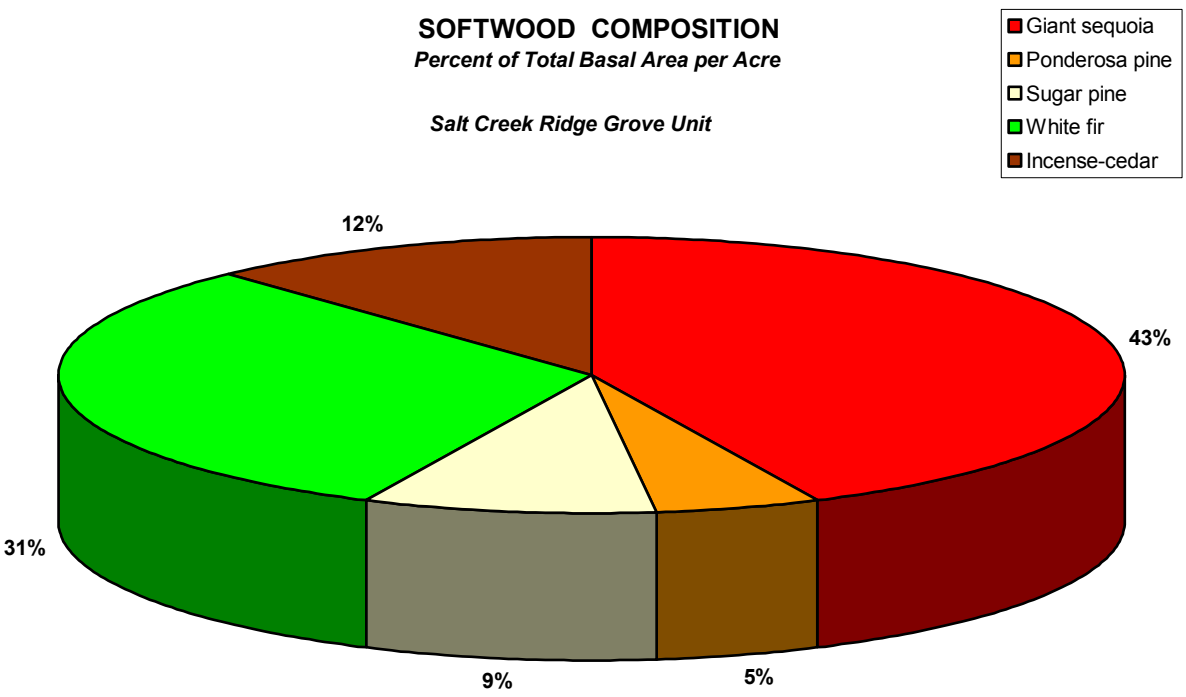
Ladybug Grove Unit

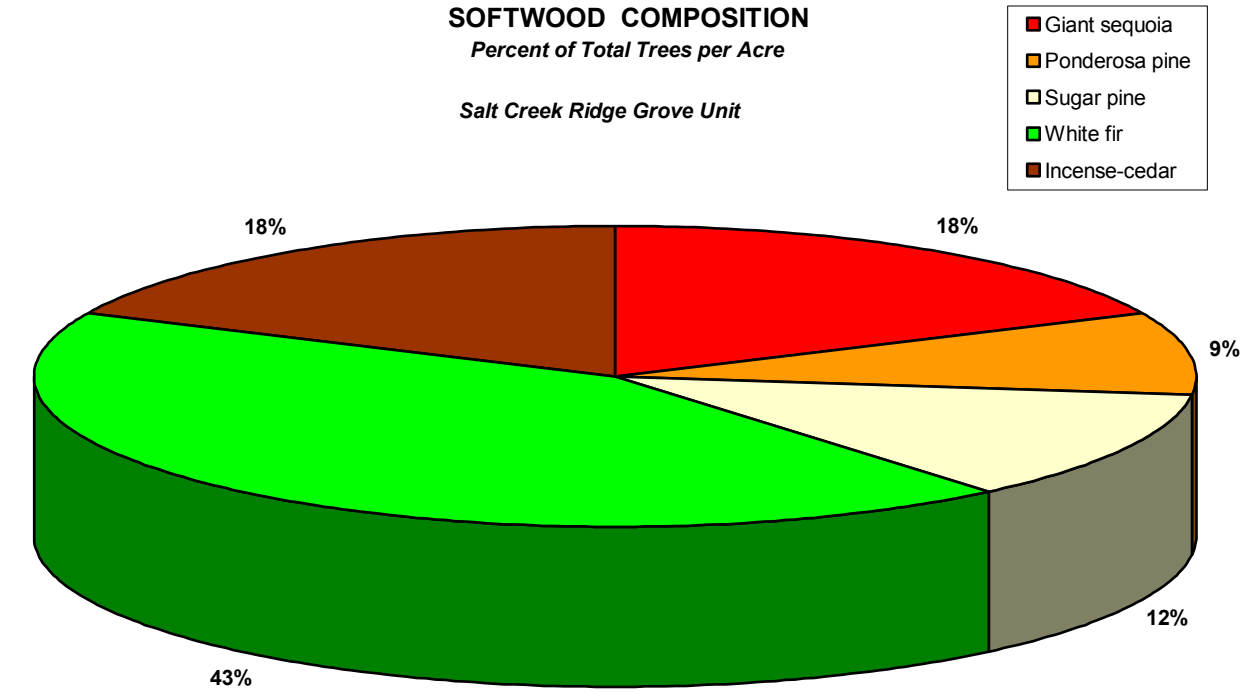


Current fuel loading = 39 tons per acre

Desired fuel loading = 18 - 43 tons per acre

Salt Creek Ridge

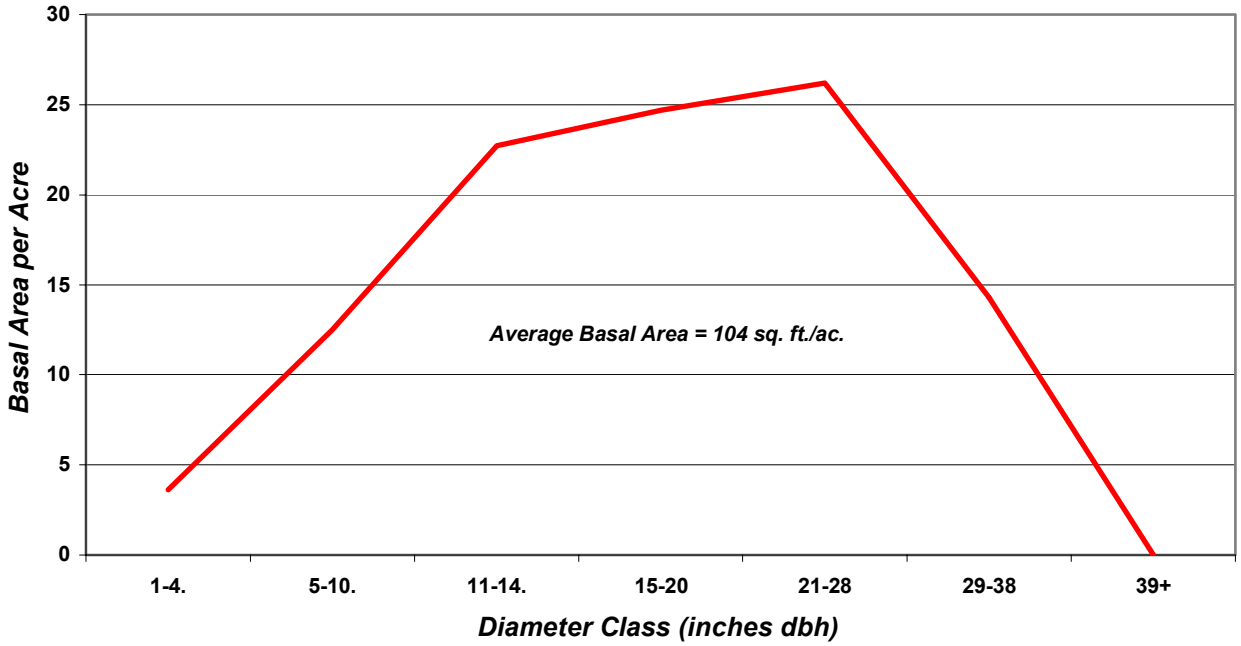

SOFTWOOD COMPOSITION
Percent of Total Basal Area per Acre
Salt Creek Ridge Grove Unit
Giant sequoia
Ponderosa pine
Sugar pine
White fir
Incense-cedar
12%
43%
31%
9%
5%


SOFTWOOD COMPOSITION
Percent of Total Trees per Acre
Salt Creek Ridge Grove Unit
Giant sequoia
Ponderosa pine
Sugar pine
White fir
Incense-cedar
18%
18%
9%
12%
43%

GROVE DENSITY by DIAMETER CLASS (conifers)

Basal Area per Acre (sq. ft.)

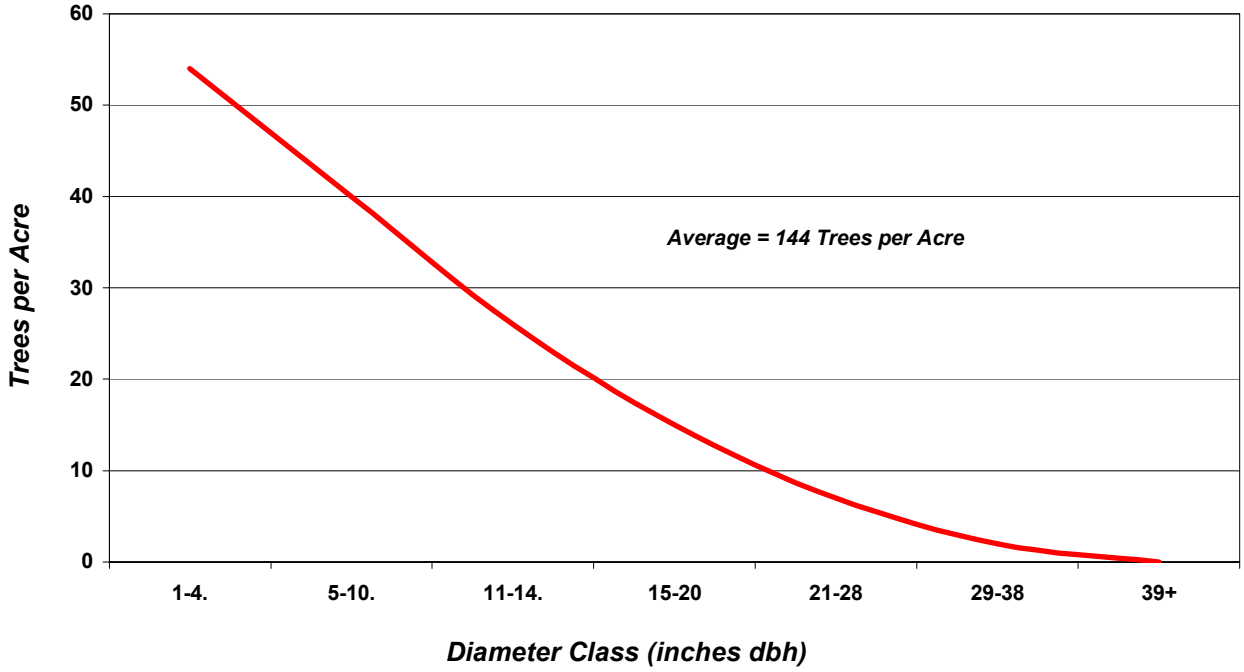
Salt Creek Ridge Grove Unit



CONIFER STOCKING

Number of Trees per Acre by Diameter Class

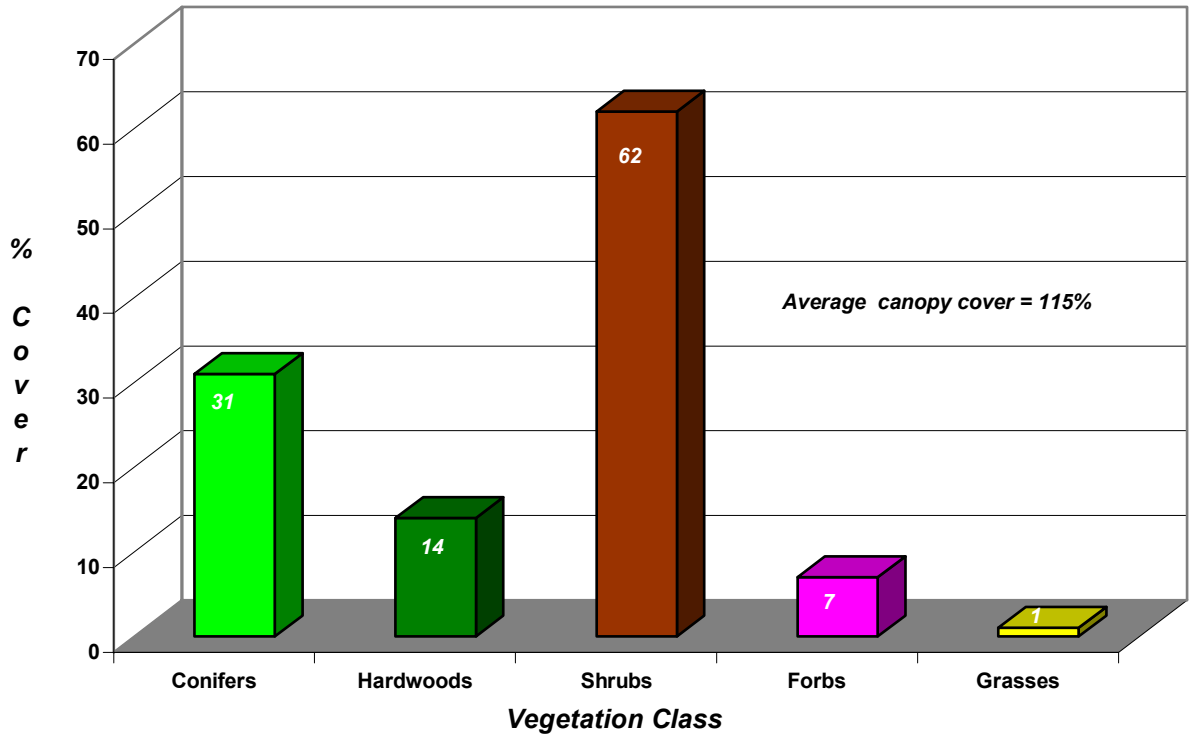
Salt Creek Ridge Grove Unit



VEGETATION COVER

Percent Canopy Cover

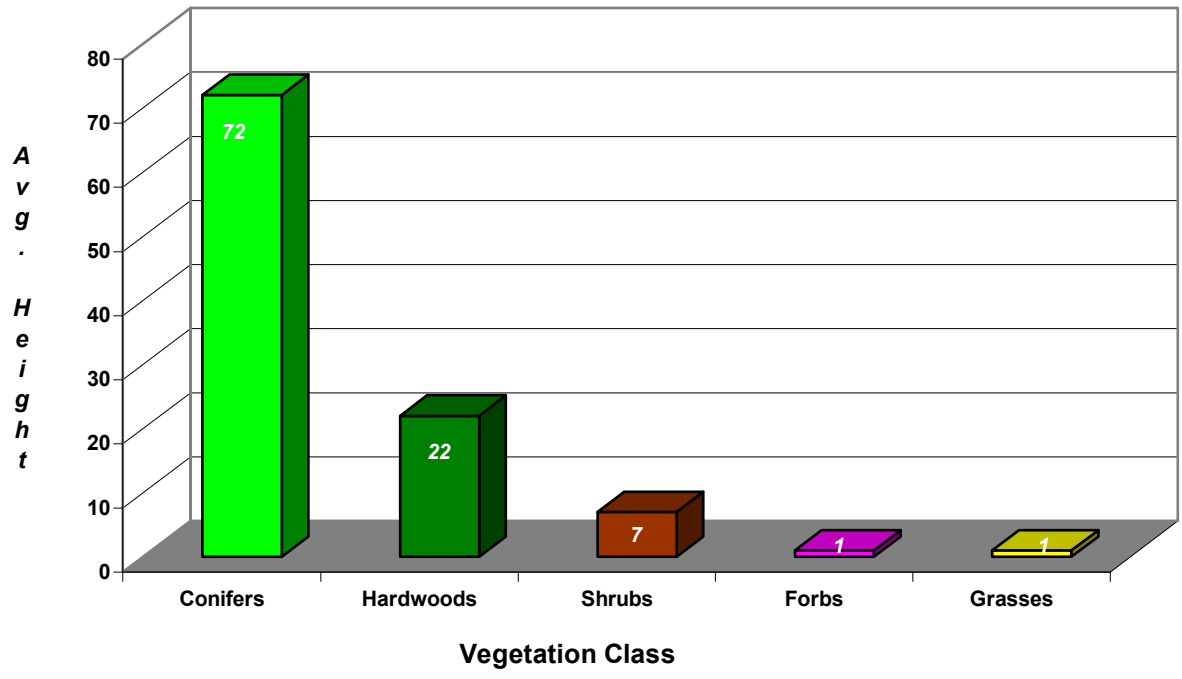
Salt Creek Ridge Grove Unit



VEGETATION COVER

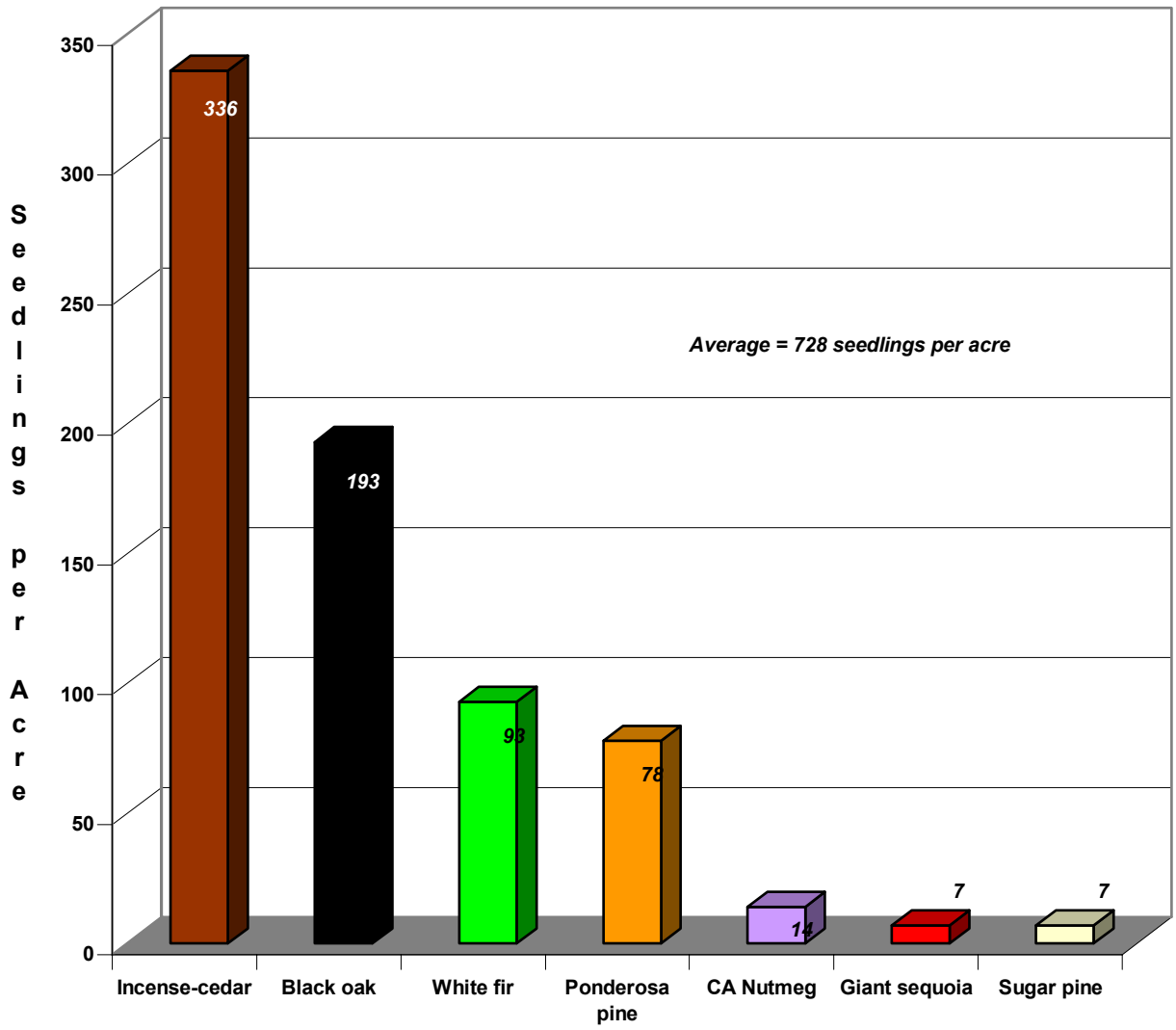
Average Height, (ft.)

Salt Creek Ridge Grove Unit



SEEDLINGS per ACRE

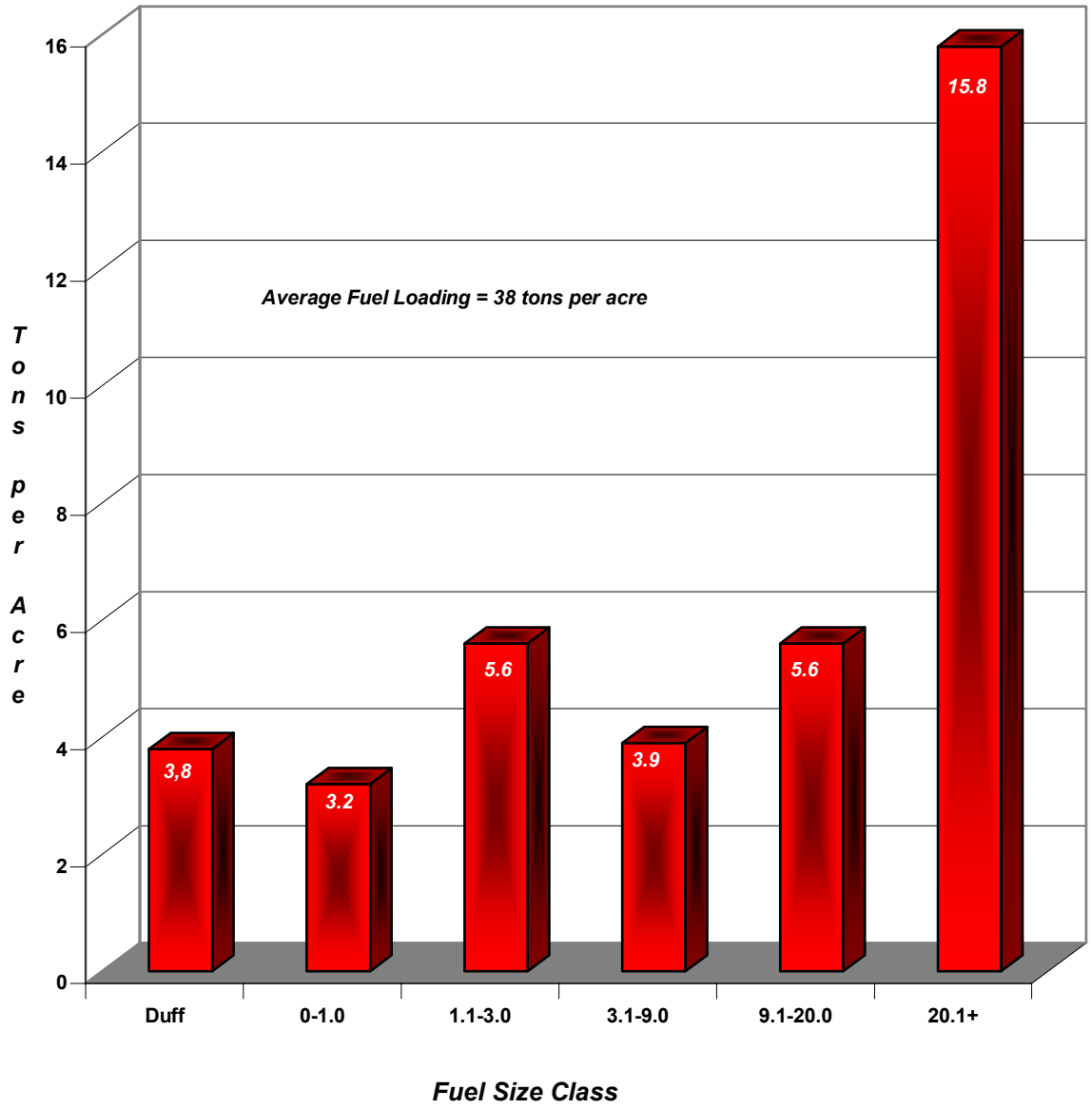
Salt Creek Ridge Grove Unit



SURFACE FUELS

Fuel Loading, Tons per Acre

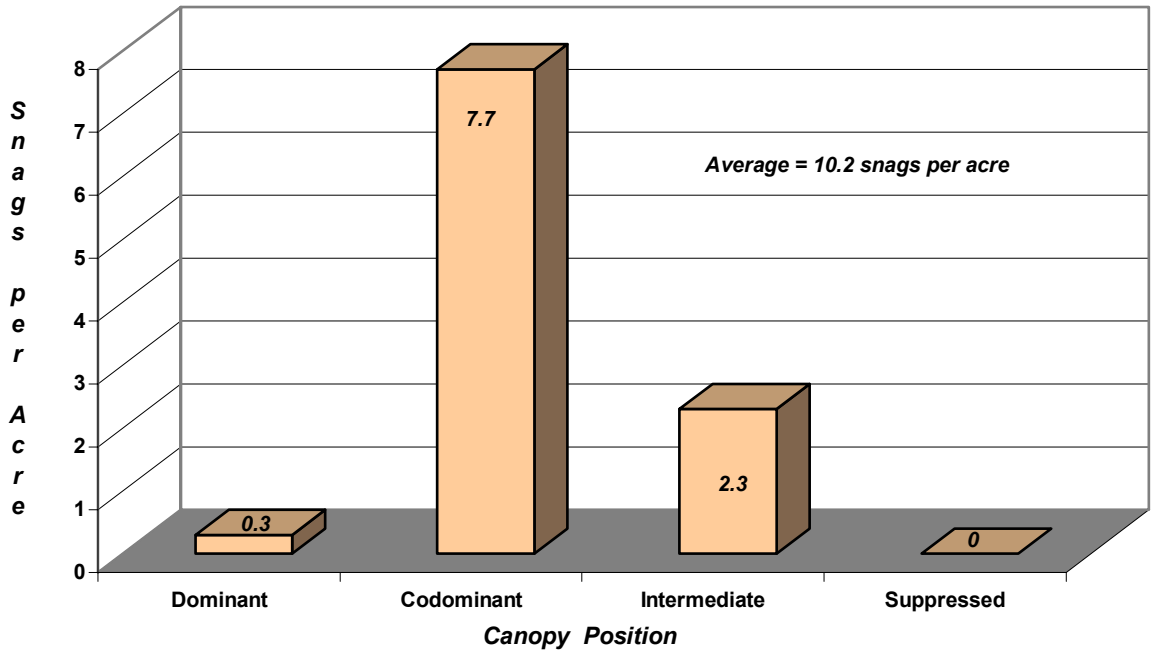
Salt Creek Ridge Grove Unit



SNAGS

Average Density per Acre by Canopy Position

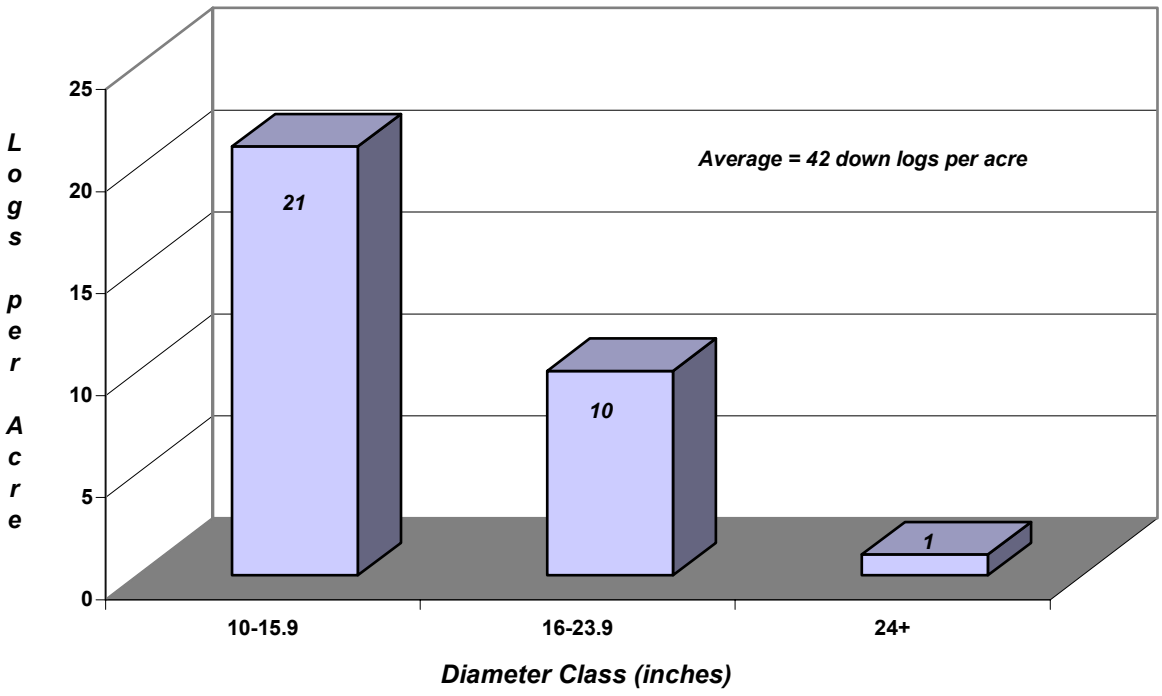
Salt Creek Ridge Grove Unit



DOWN LOGS

Average Density per Acre by Diameter Class

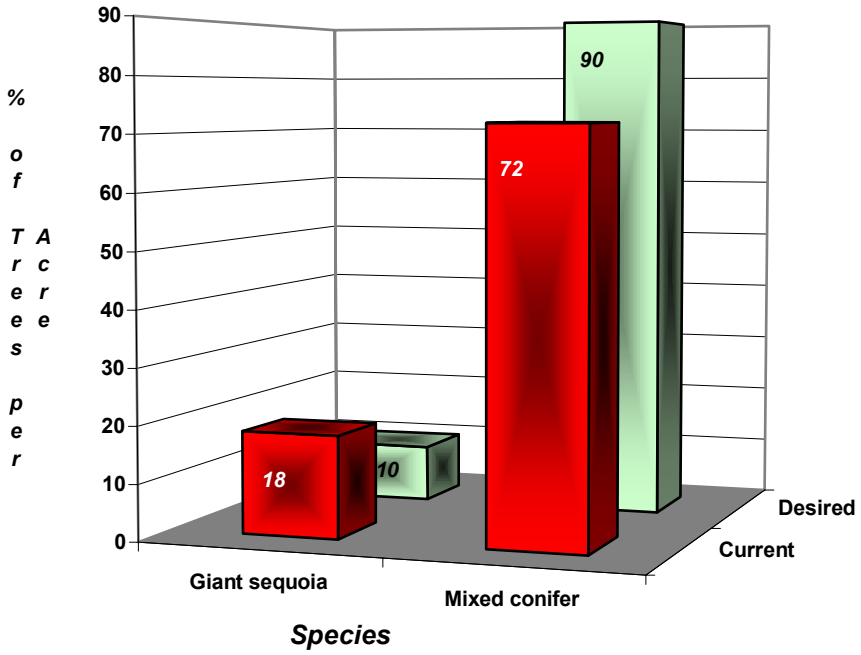
Salt Creek Ridge Grove Unit



COMPARISON of CURRENT to DESIRED

Percent of Trees per Acre

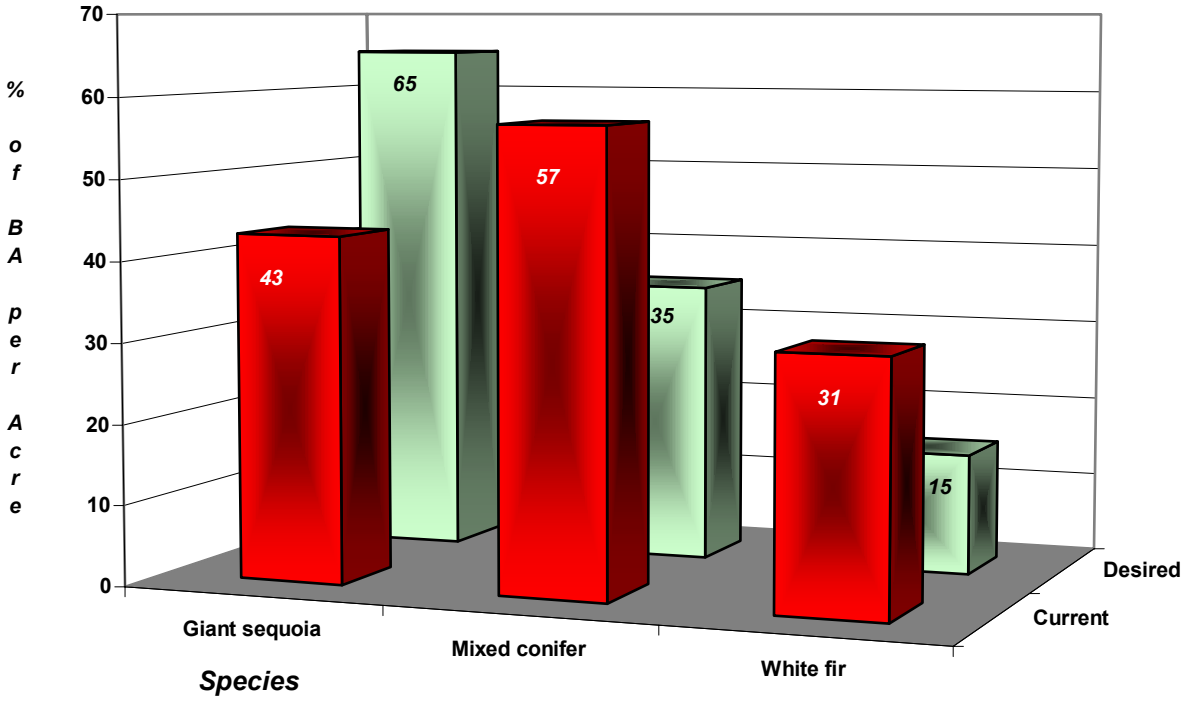
Salt Creek Ridge Grove Unit



COMPARISON of CURRENT to DESIRED

Percent of Total Basal Area per Acre (sq. ft.)

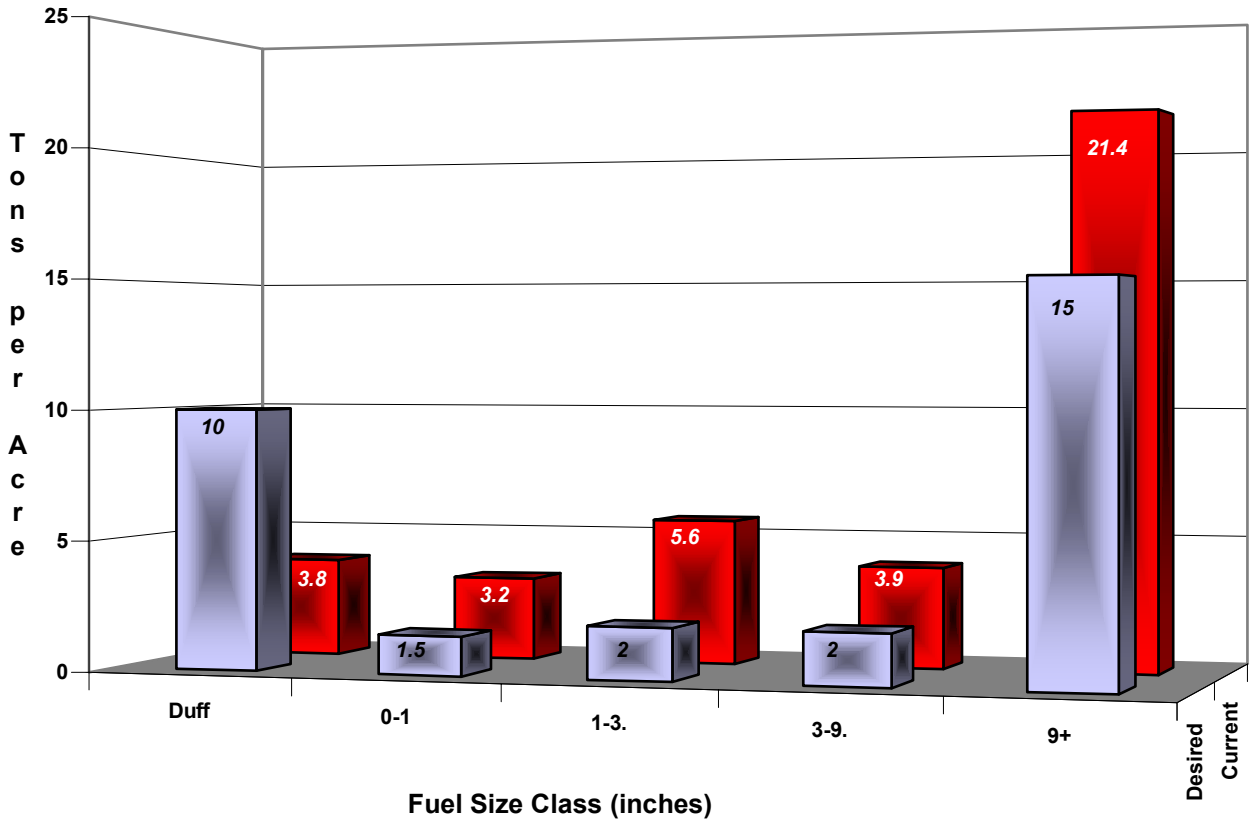
Salt Creek Ridge Grove Unit



COMPARISON of CURRENT to DESIRED SURFACE FUELS

Fuel Loading, Tons per Acre

Salt Creek Ridge Grove Unit



Current fuel loading = 37.9 tons per acre

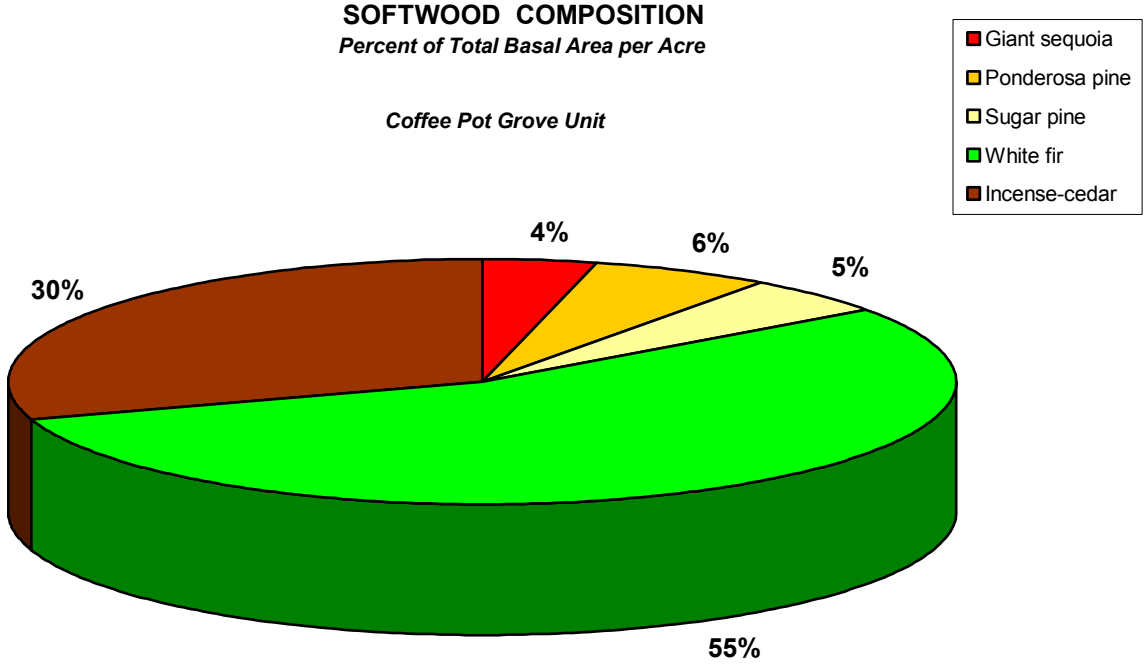
Desired fuel loading = 18 - 43 tons per acre

Coffee Pot

SOFTWOOD COMPOSITION

Percent of Total Basal Area per Acre

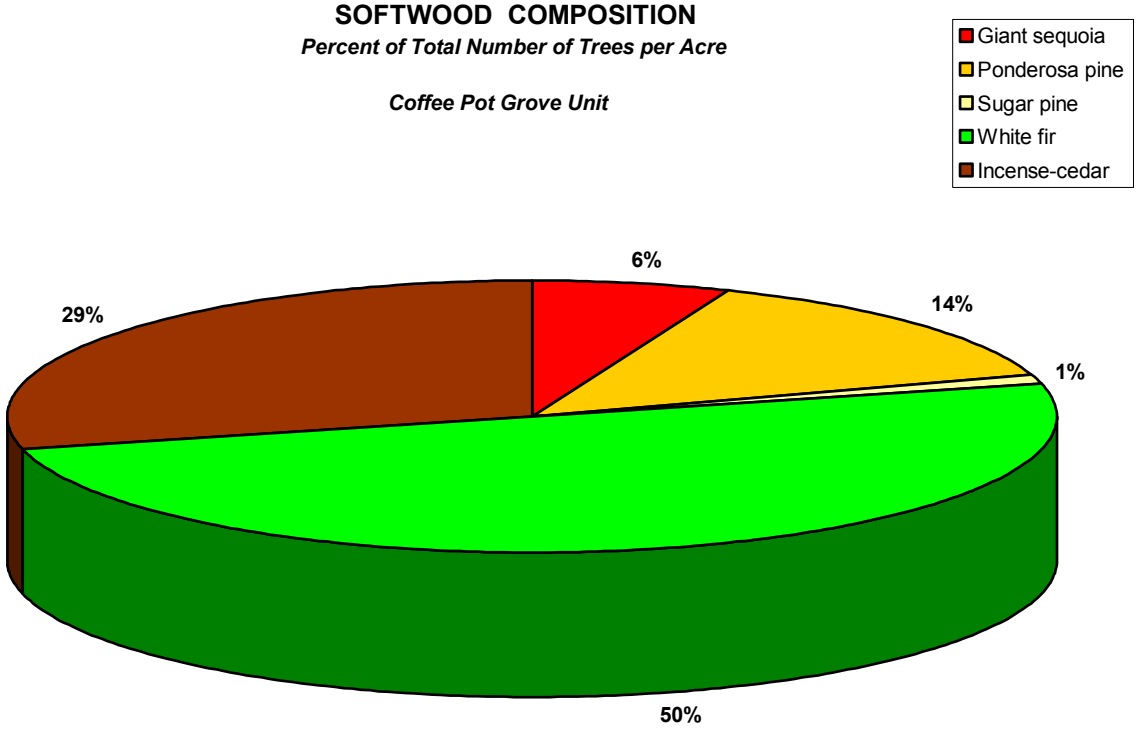
Coffee Pot Grove Unit



SOFTWOOD COMPOSITION

Percent of Total Number of Trees per Acre

Coffee Pot Grove Unit



GROVE DENSITY by TREE DIAMETER CLASS (conifers)

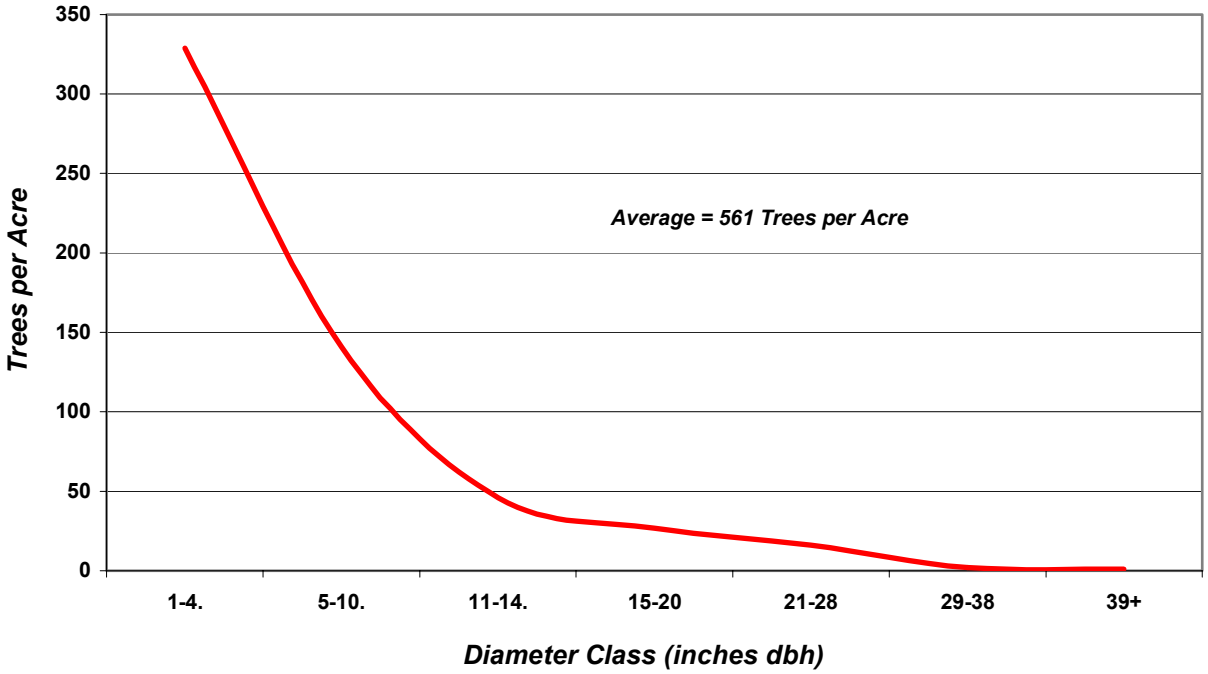
Basal Area per Acre

Coffee Pot Grove Unit

CONIFER STOCKING

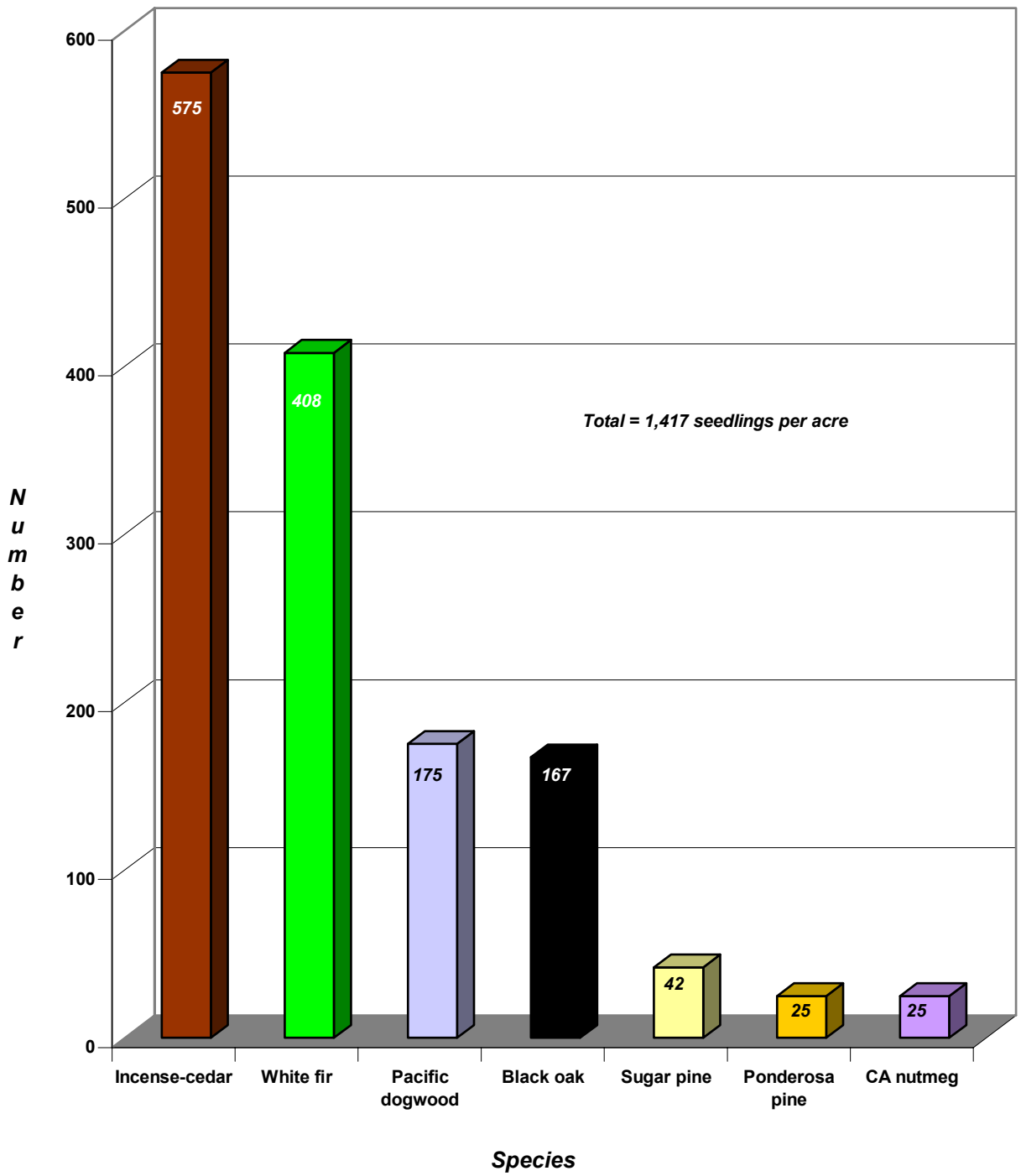
Number of Trees per Acre by Diameter Class

Coffee Pot Grove Unit



SEEDLINGS per ACRE

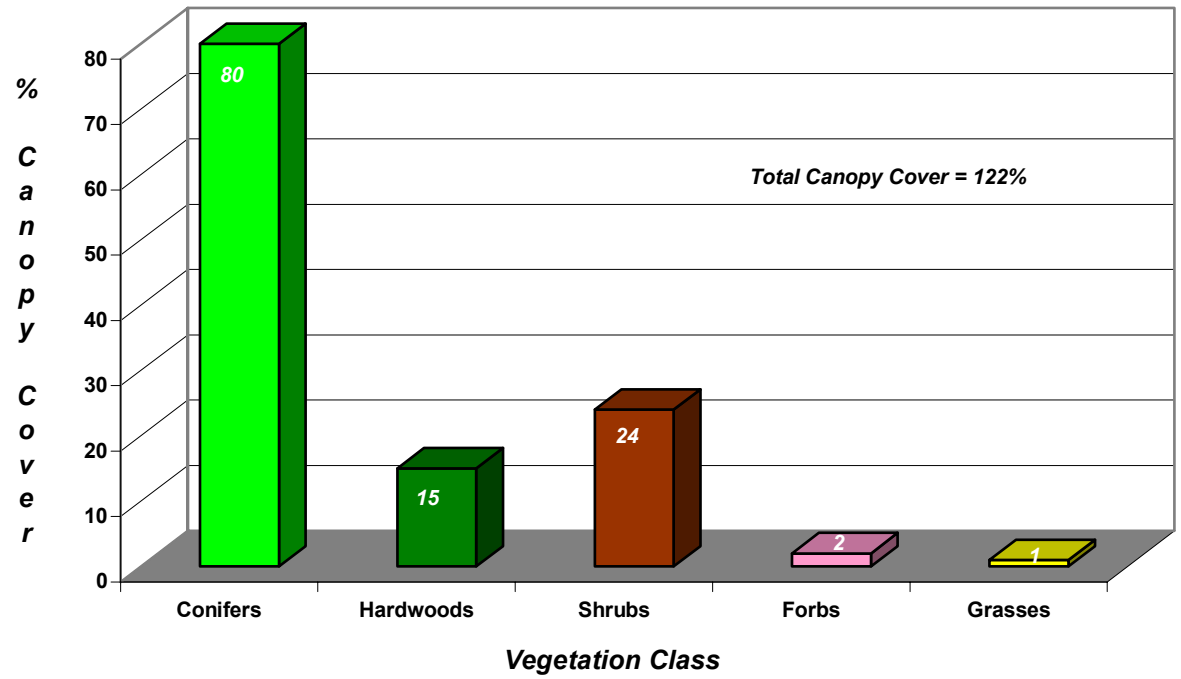
Coffee Pot Grove Unit



VEGETATION COVER

Percent Canopy Cover

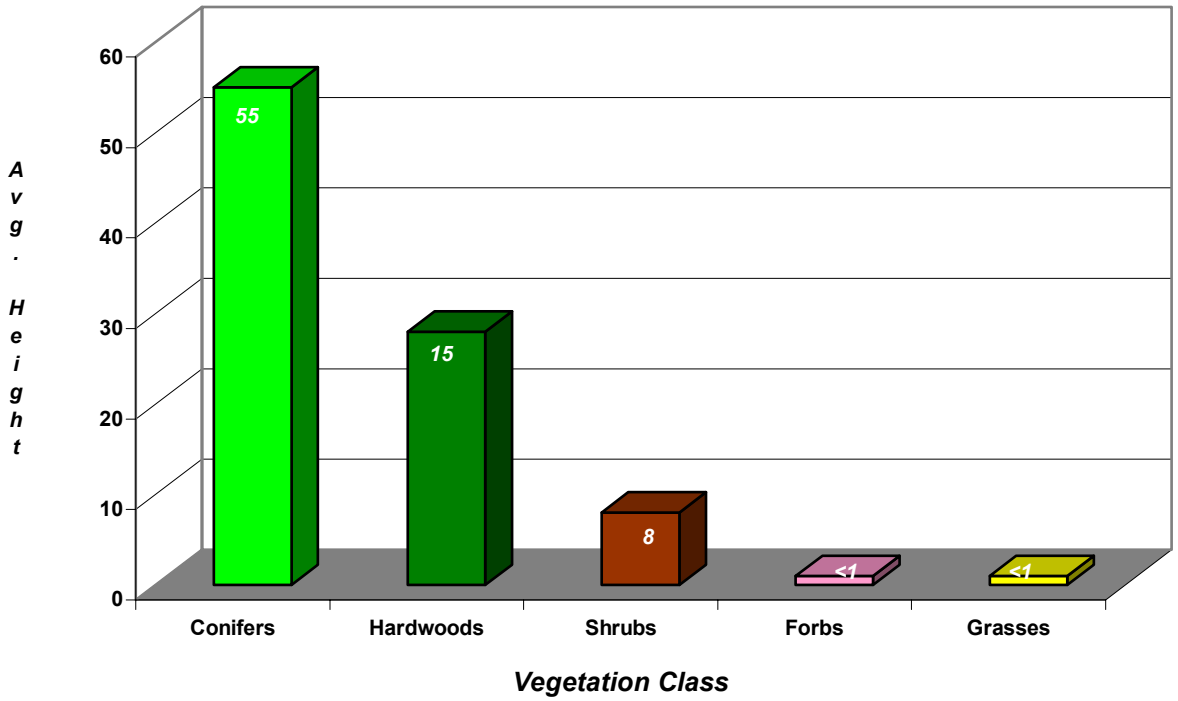
Coffee Pot Grove Unit



VEGETATION COVER

Average Height (ft.)

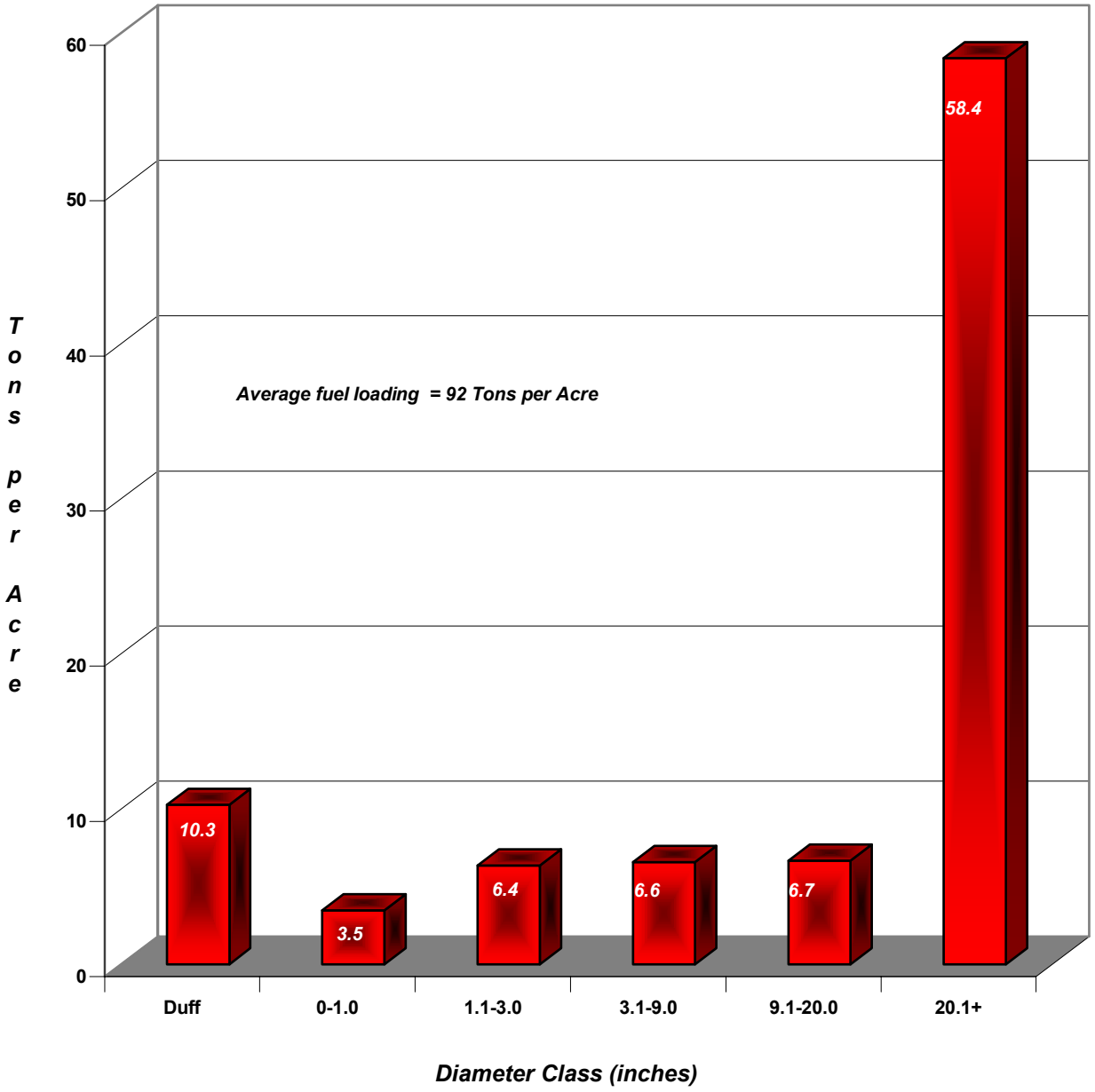
Coffee Pot Grove Unit



SURFACE FUELS

Fuel Loading, Tons per Acre

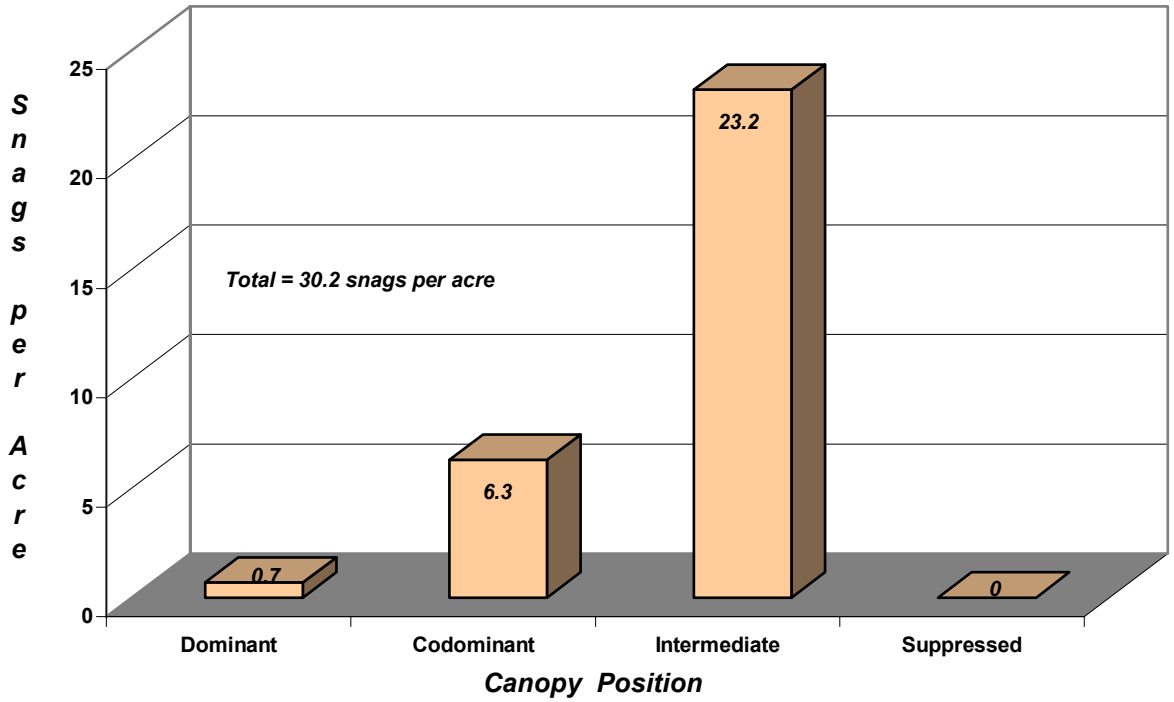
Coffee Pot Grove Unit



SNAGS

Average Density per Acre by Canopy Position

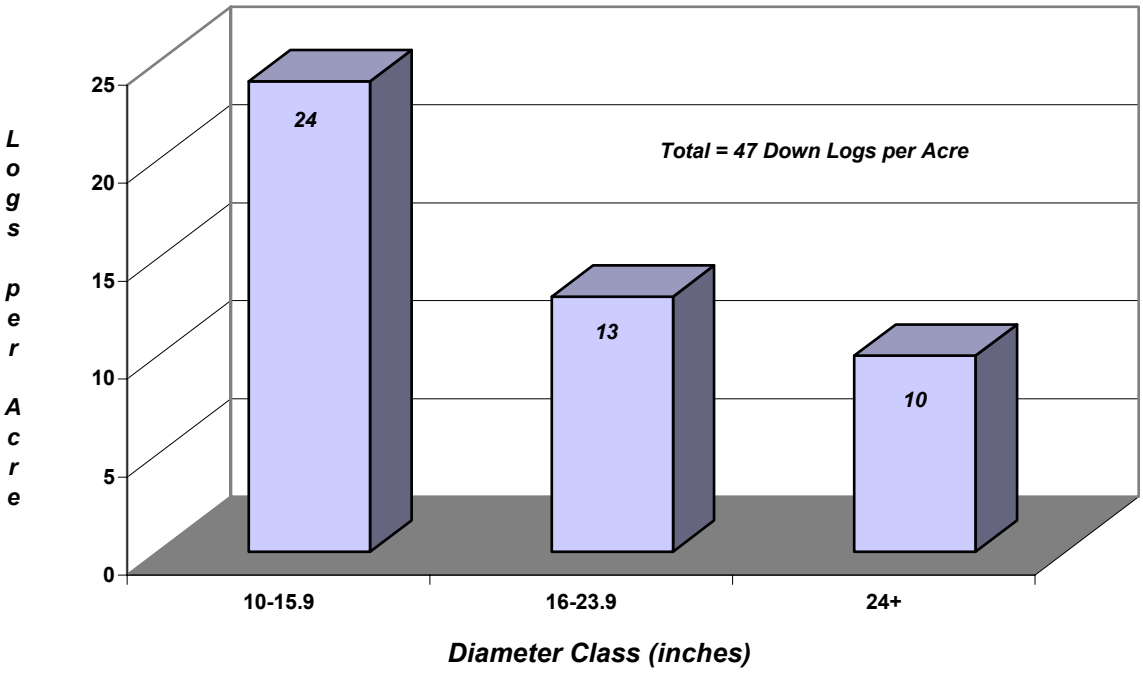
Coffee Pot Grove Unit



DOWN LOGS

Average Density per Acre by Diameter Class

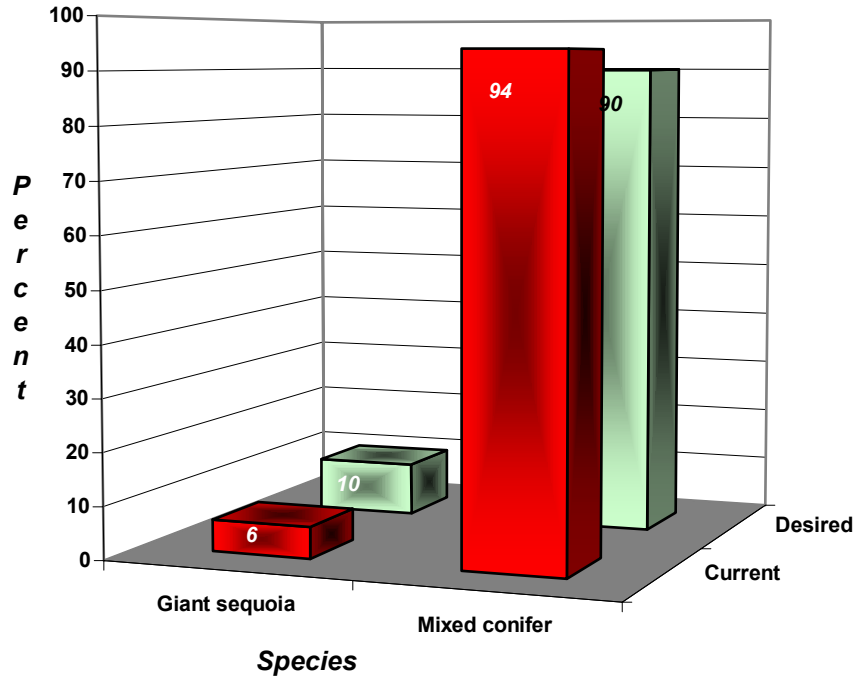
Coffee Pot Grove Unit



COMPARISON of CURRENT to DESIRED

Percent of Total Trees per Acre

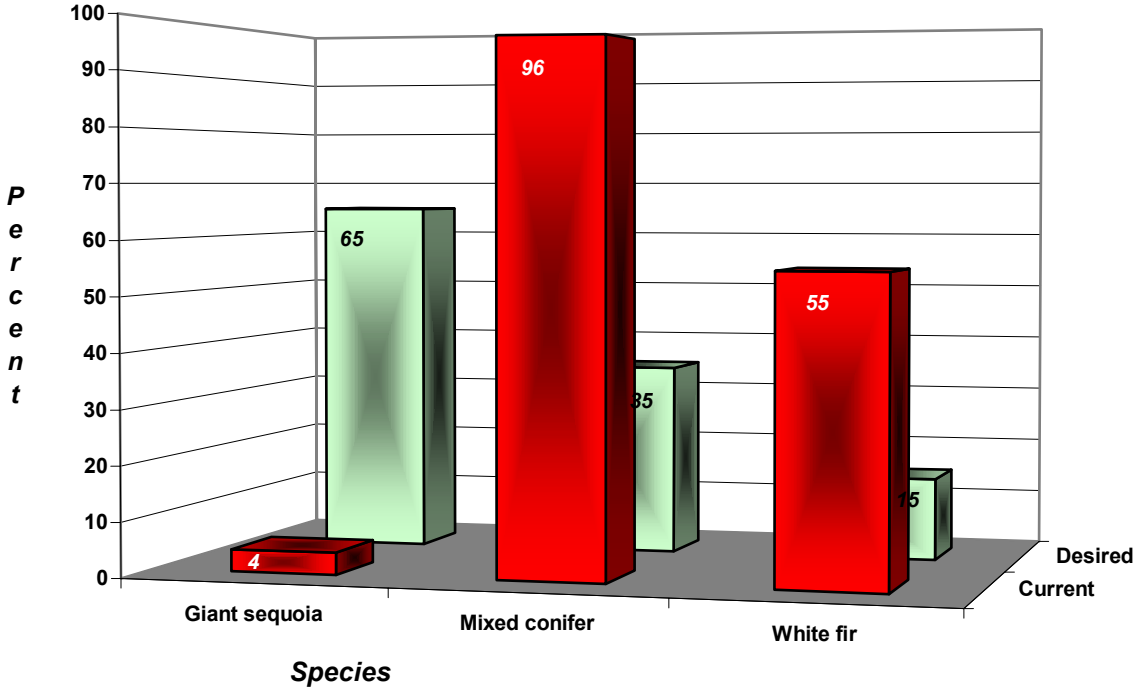
Coffee Pot Grove Unit



COMPARISON of CURRENT to DESIRED

Percent of Total Basal Area per Acre

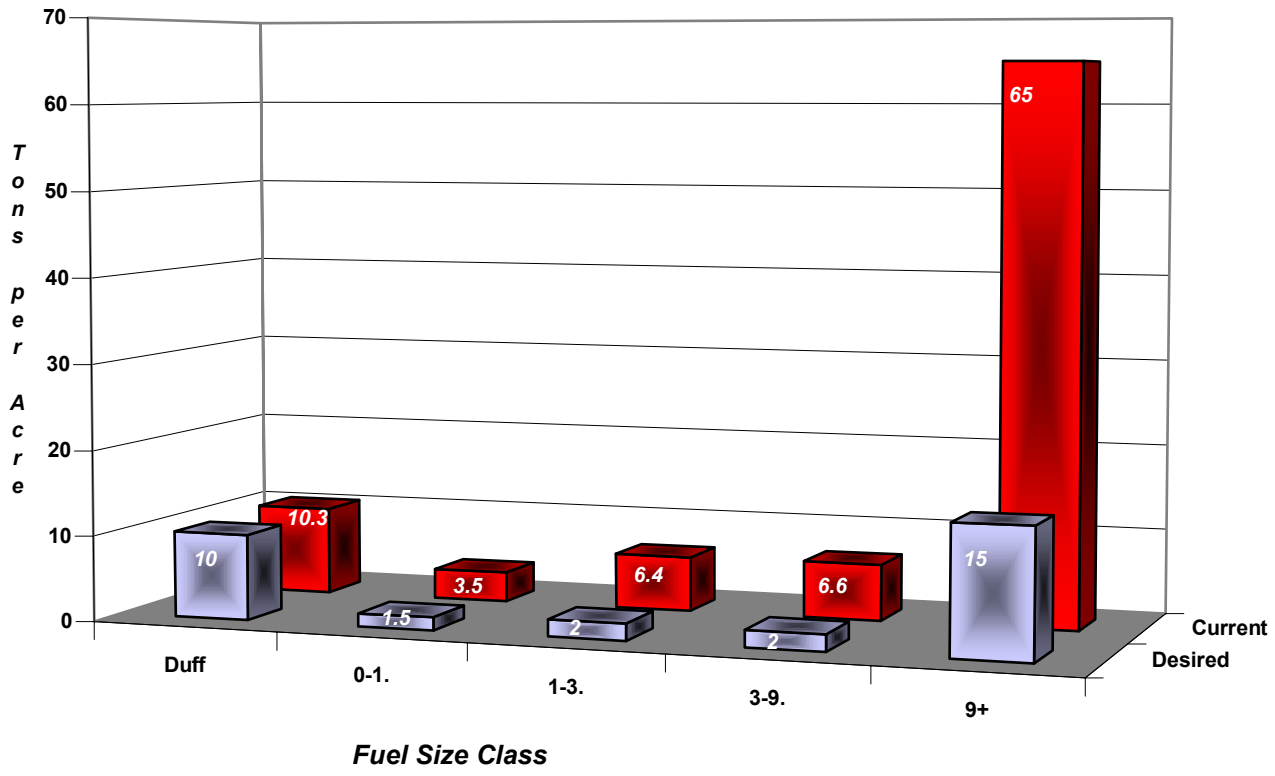
Coffee Pot Grove Unit



COMPARISON of CURRENT to DESIRED SURFACE FUELS

Fuel Loading, Tons per Acre

Coffee Pot Grove Unit



Current fuel loading = 92 tons per acre

Desired fuel loading = 18 - 43 tons per acre

Photo Gallery

Nutmeg

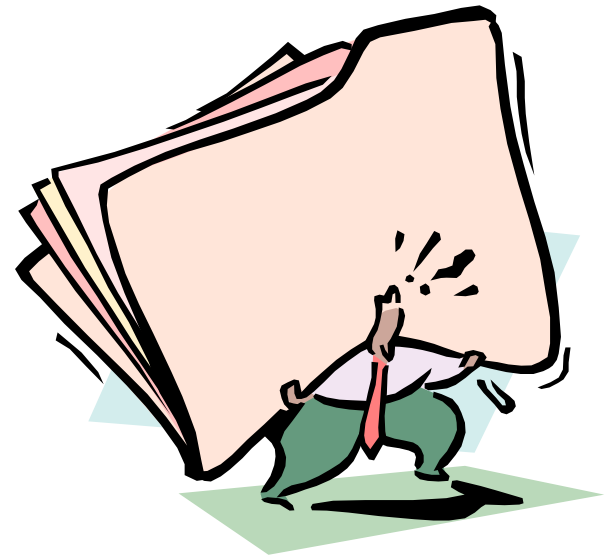
Case

Monache Tubs

Ladybug

Salt Creek Ridge

Coffee Pot



Nutmeg

Case

Monache Tubs

Ladybug

Salt Creek Ridge

Coffee Pot

Nutmeg

Case

Monache Tubs

Ladybug

Salt Creek Ridge

Coffee Pot

BLM Giant Sequoia Tree Census